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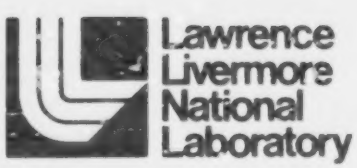
UCID-21002
Vol. 2

Component Fragility Research Program
Phase I Demonstration Tests

Volume 2: Appendices

G. S. Holman, C. K. Chou, G. D. Shipway, V. Glozman

Prepared for
U.S. Nuclear Regulatory Commission



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Vol. 2

Component Fragility Research Program
Phase I Demonstration Tests

Volume 2: Appendices

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APPENDIX A

Details of Controller and Relay Installation

APPENDIX A

This appendix presents "open-door" photographs of each compartment in the motor control center tested. MCC columns are numbered left to right, and are divided into 12 6-inch high spaces A through M between the top and bottom horizontal raceways. Compartments are identified according to the following designation code:

Compartment "2J" is therefore located in the second column and has its bottom at elevation "J" (i.e., 27 inches from the cabinet base). Note that the compartments themselves vary from 12 to 24 inches in height.

Figure A-1 diagrams the general arrangement of motor controllers, relays, and accelerometers in the motor control center. Controllers are identified according to starter size; an "S-2" controller, for example, uses a NEMA Size 2 starter. Reversing controllers are identified by an "R" suffix. Westinghouse, General Electric, and Cutler-Hammer relays are identified according to manufacturer (i.e., "W", "GE", and "CH") while Square-D relays are identified according to model (i.e., "KX" and "KP"). Accelerometer locations are identified by numbered circles (horizontal orientation) or squares (vertical orientation).

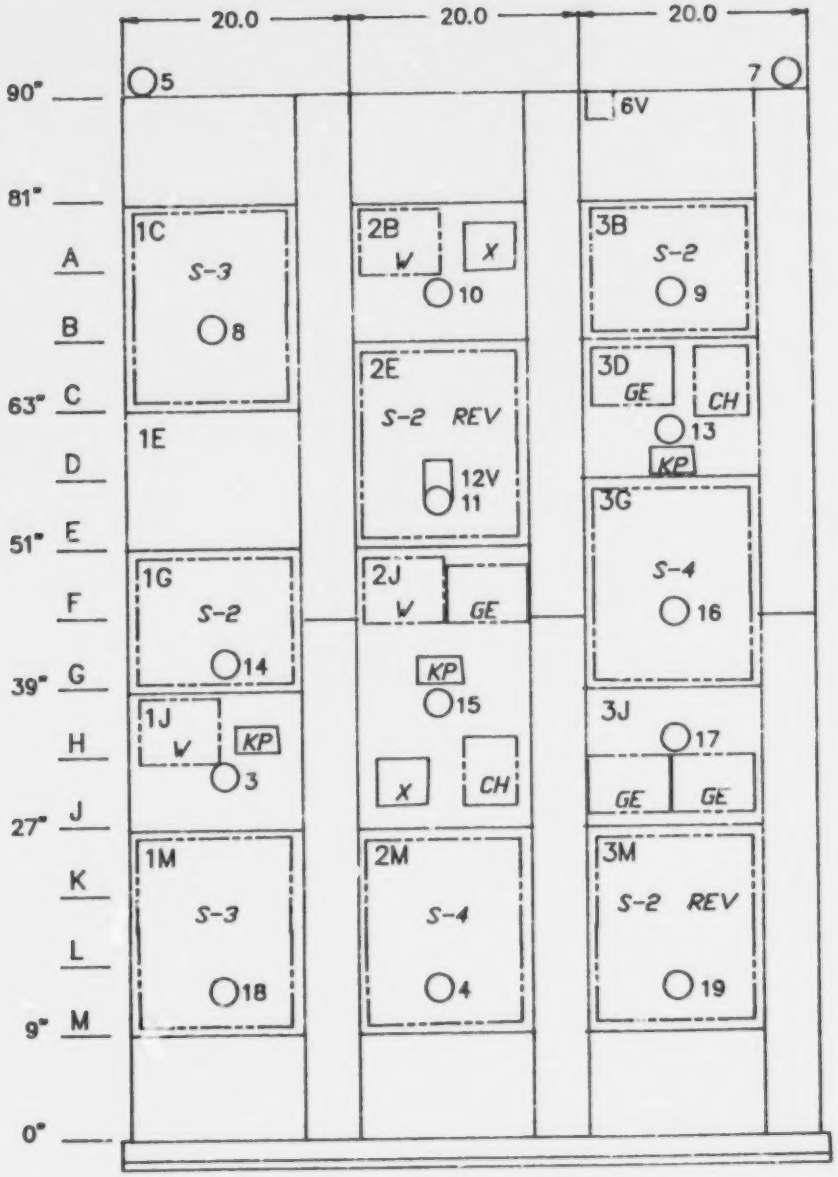

Fig. A-1. General arrangement of controllers, relays, and accelerometers during MCC testing.

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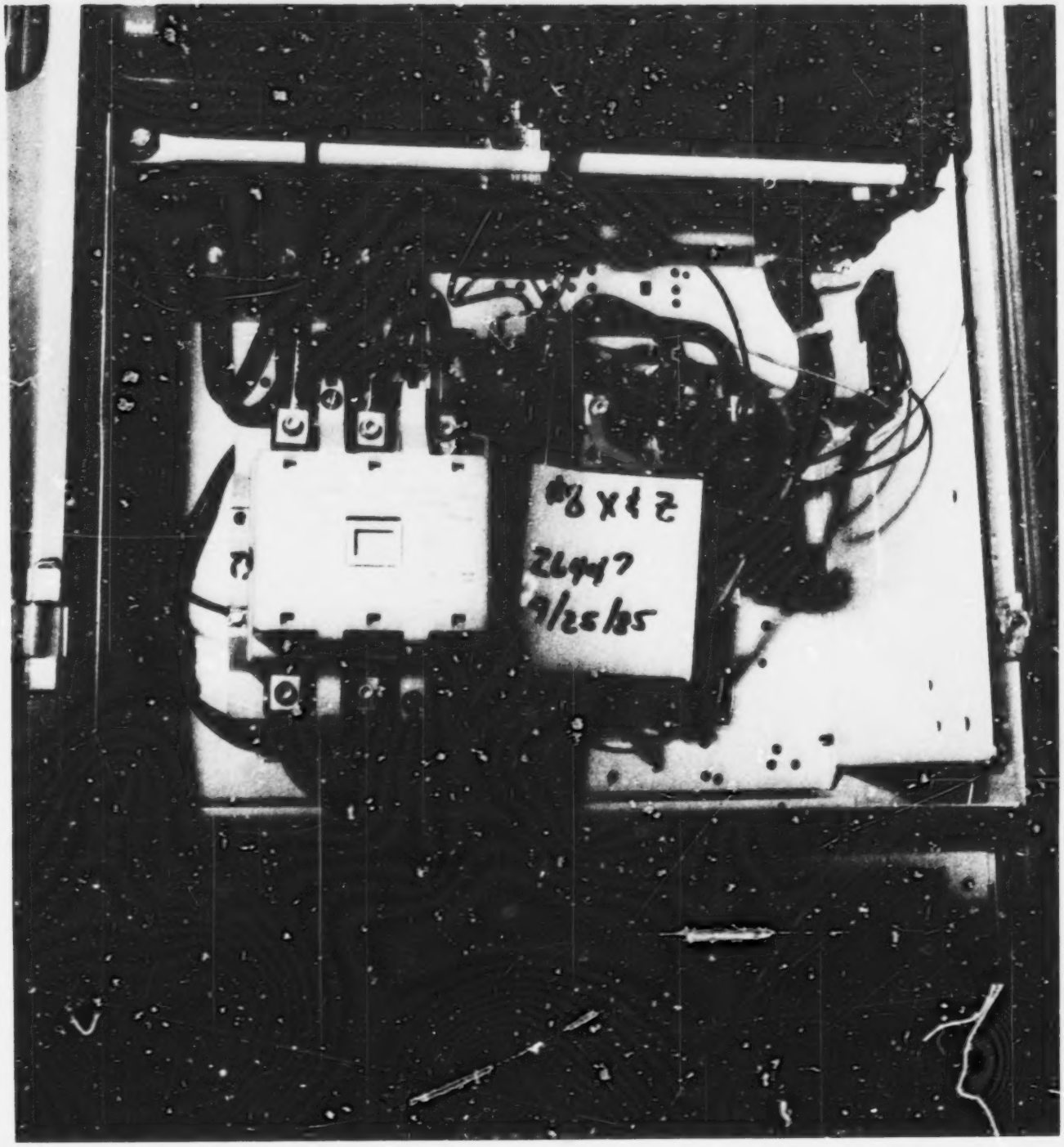

Fig. A-2. Detail of MCC compartment 1C (Westinghouse Size 3 FVNR controller).

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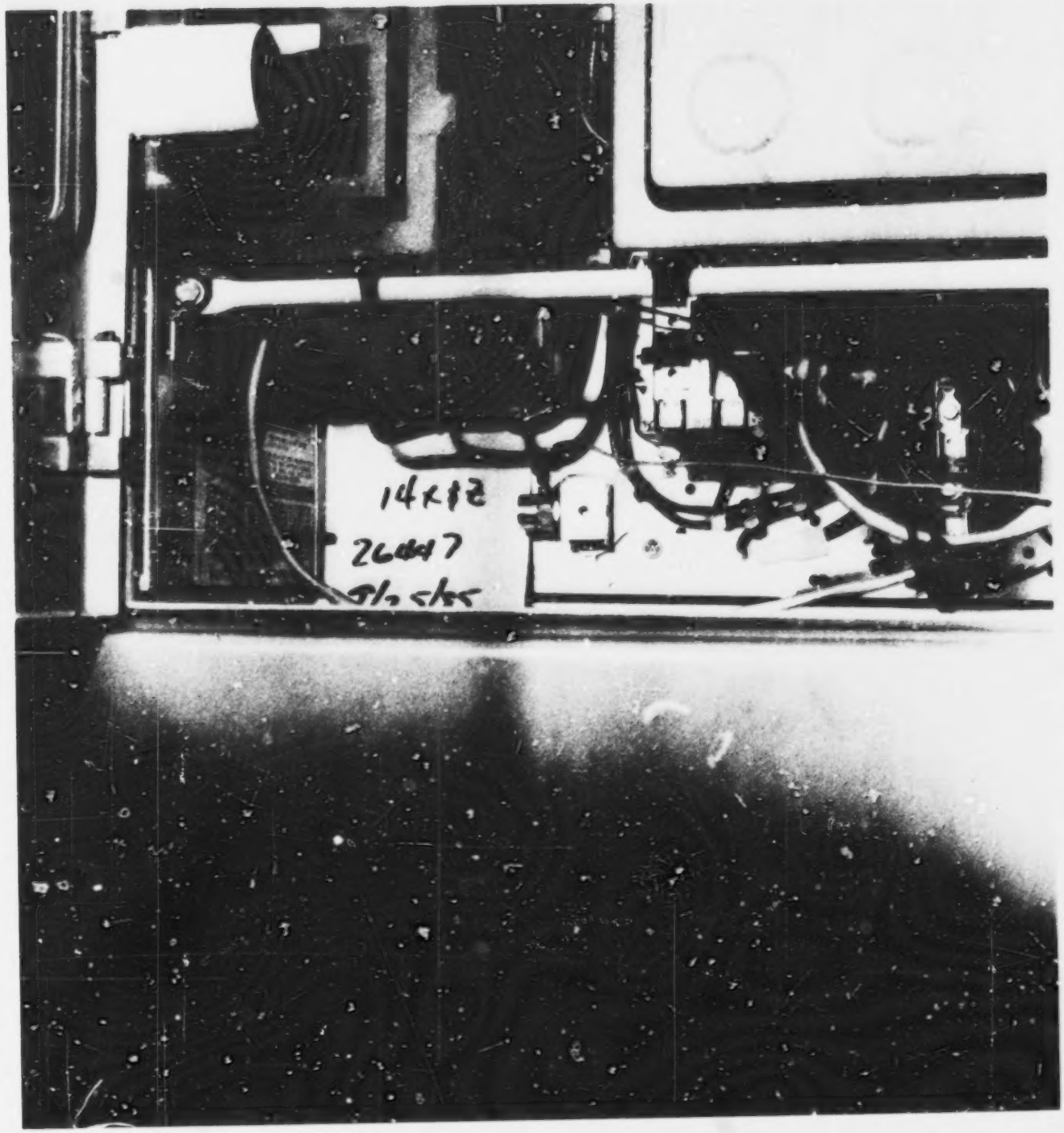

Fig. A-3. Detail of MCC compartment 1G (Westinghouse Size 2 FVNR controller).

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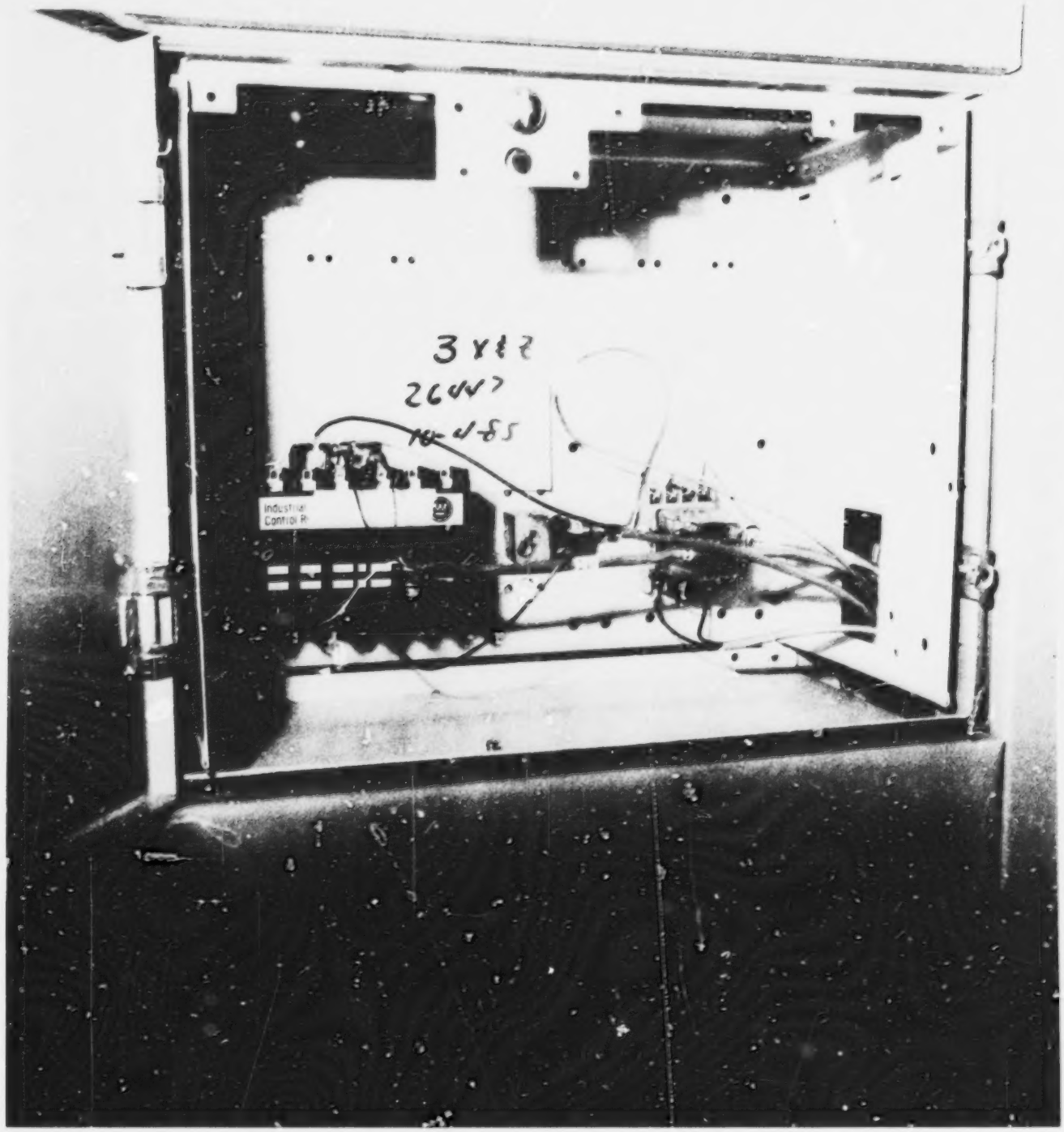

Fig. A-4. Detail of MCC compartment 1J (Westinghouse Type AR relay, Square-D Type KP relay).

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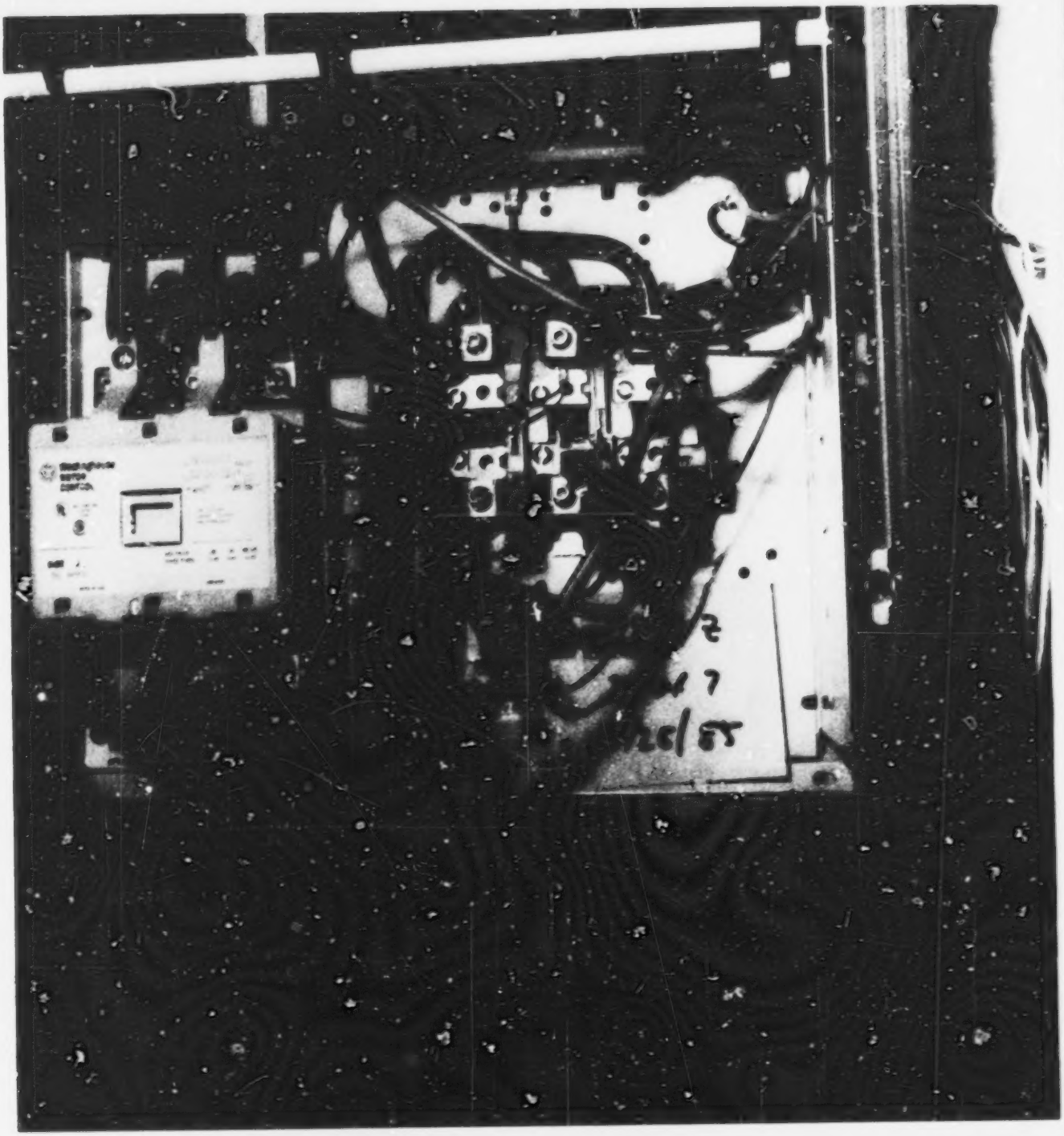

Fig. A-5. Detail of MCC compartment 1M (Westinghouse Size 3 FVNR controller).

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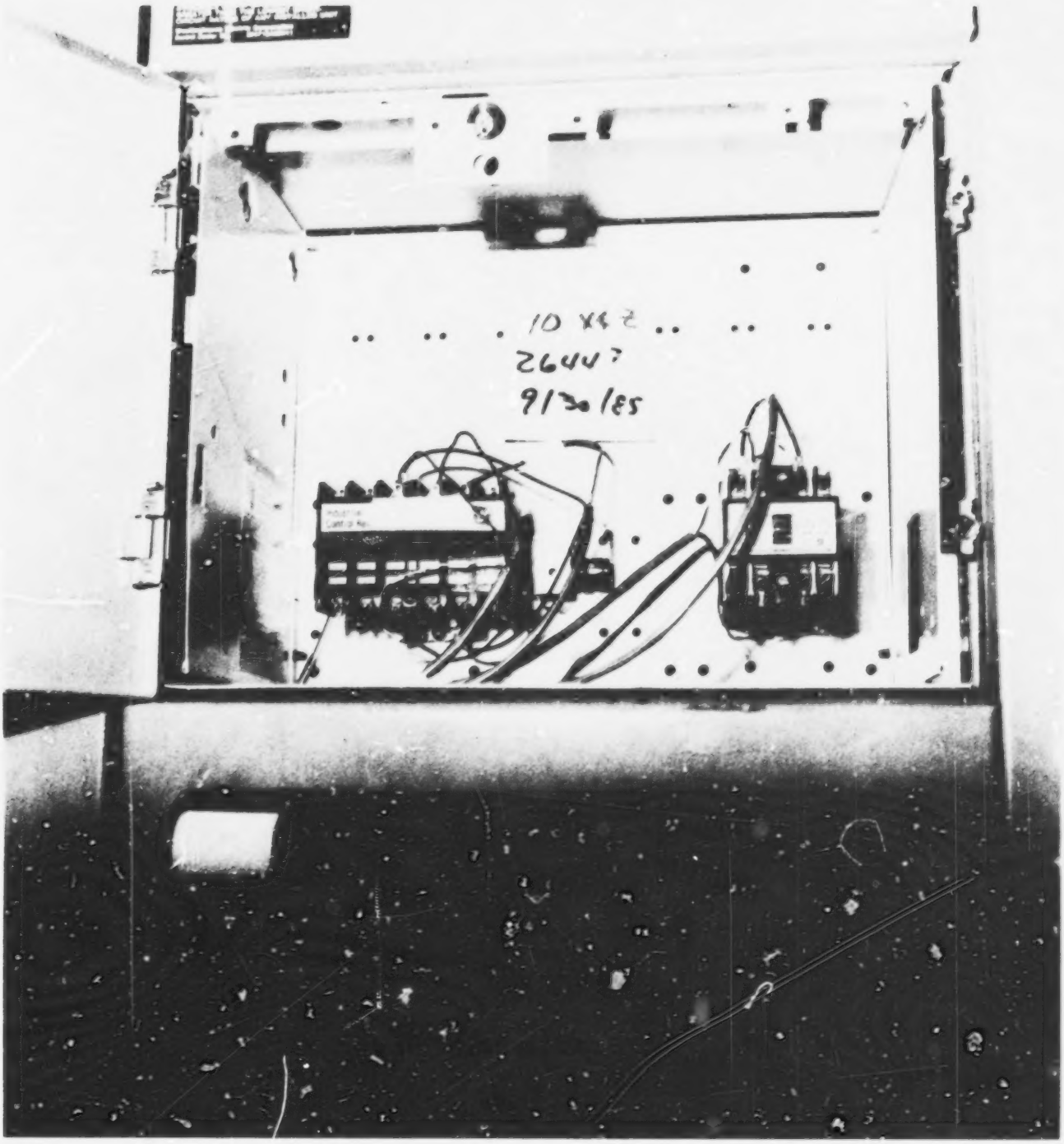

Fig. A-6. Detail of MCC compartment 2B (Westinghouse Type AR relay, Square-D Type X relay).

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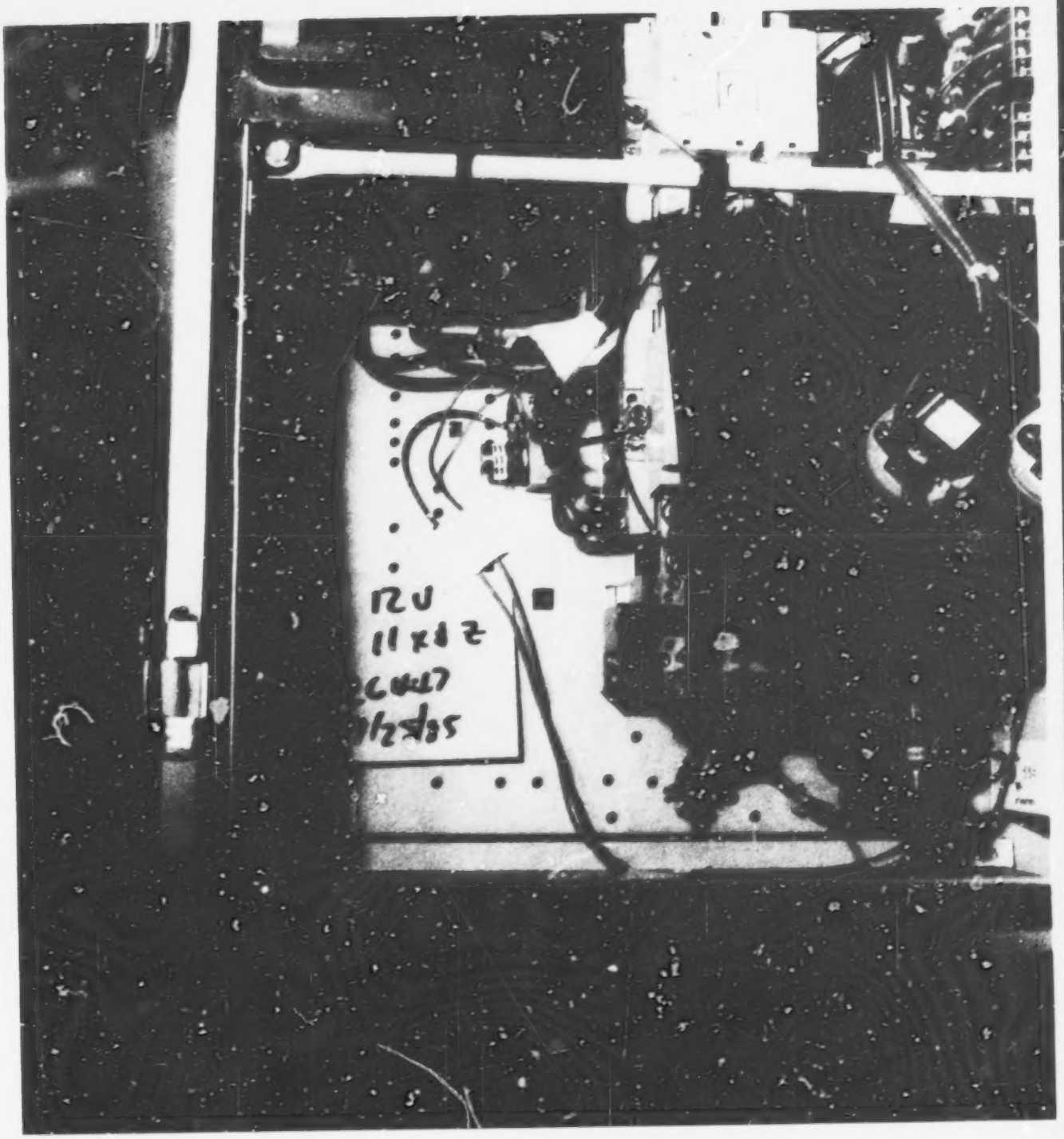

Fig. A-7. Detail of MCC compartment 2E (Westinghouse Size 2 FVR controller).

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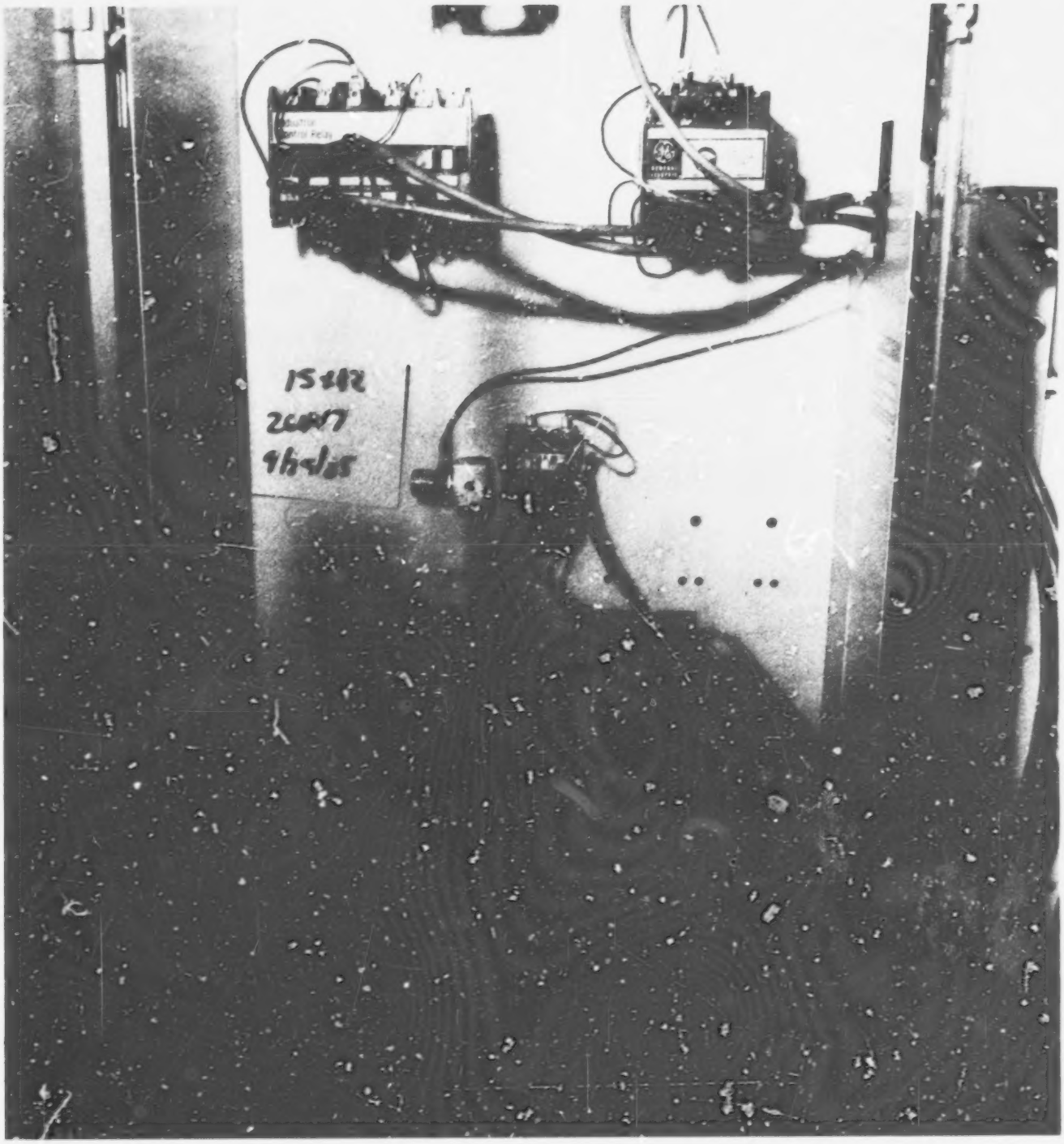

Fig. A-8. Detail of MCC compartment 2J (Westinghouse Type AR relay, General Electric Type CR relay, Cutler-Hammer Powerreed relay, Square-D Type X and Type KP relays).

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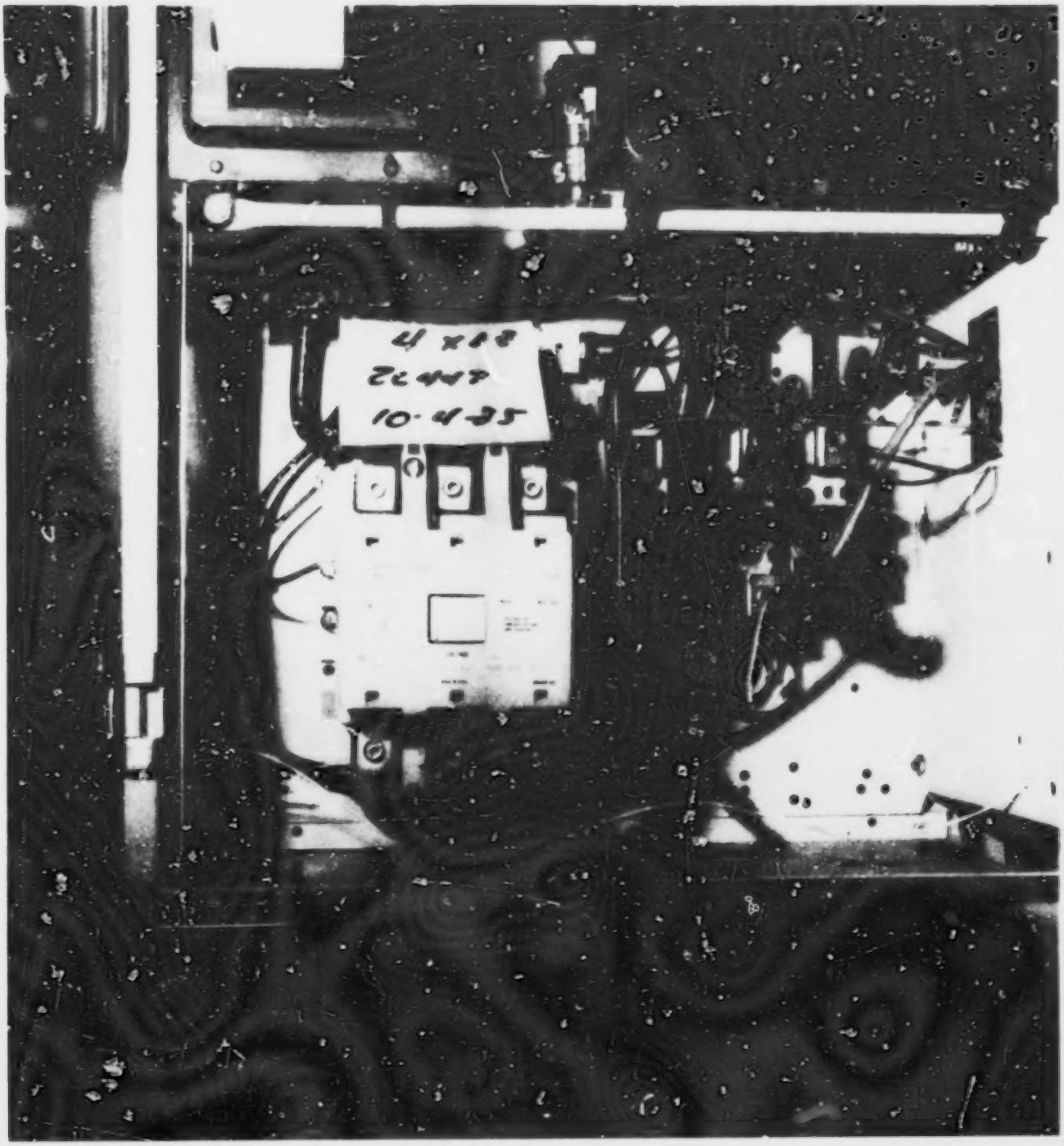

Fig. A-9. Detail of MCC compartment 2M (Westinghouse Size 4 FVNR controller).

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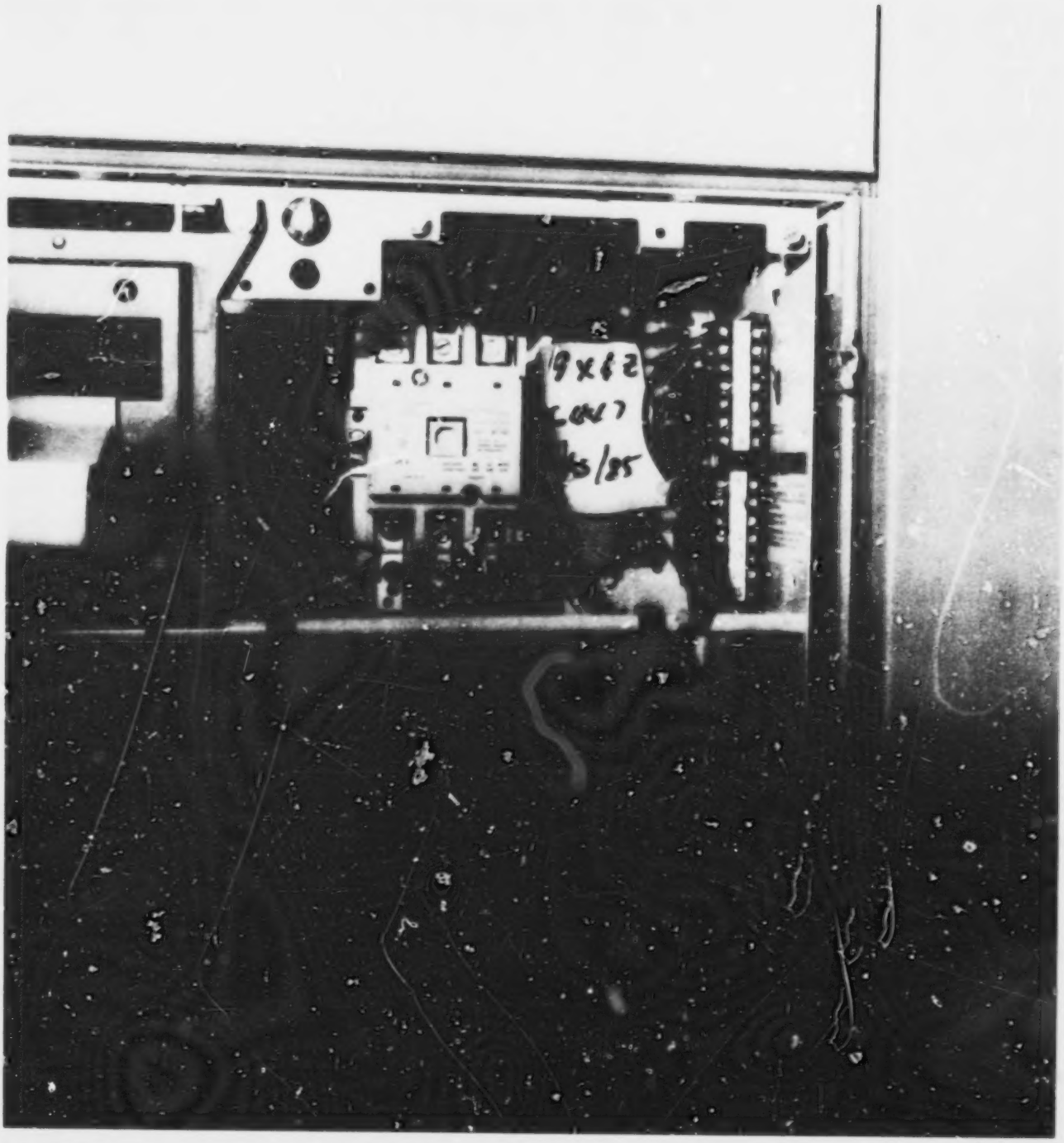

Fig. A-10. Detail of MCC compartment 3B (Westinghouse Size 2 FVNR controller).

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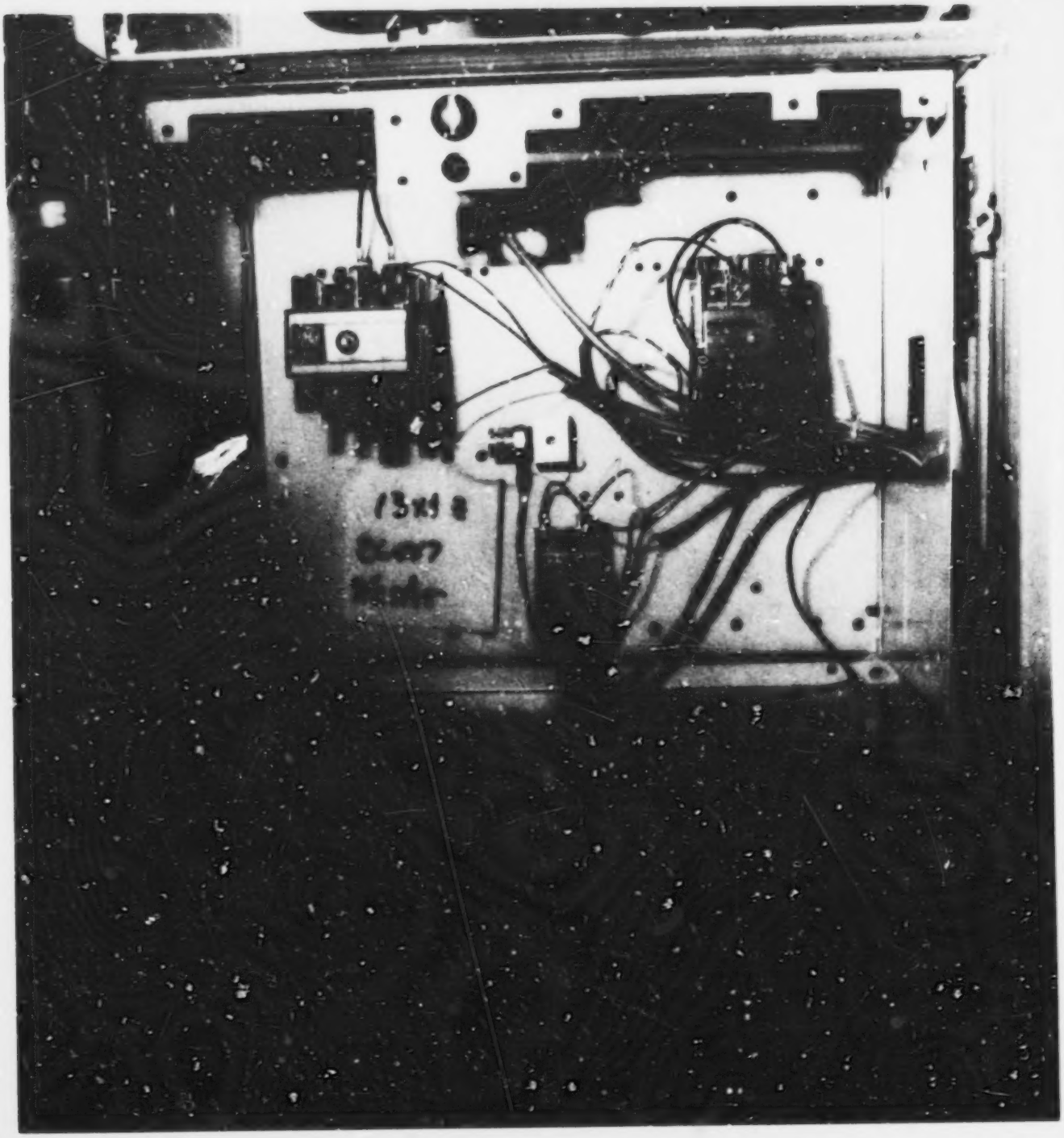

Fig. A-11. Detail of MCC compartment 3D (General Electric Type CR relay, Cutler-Hammer Powerreed relay, Square-D Type KP relay).

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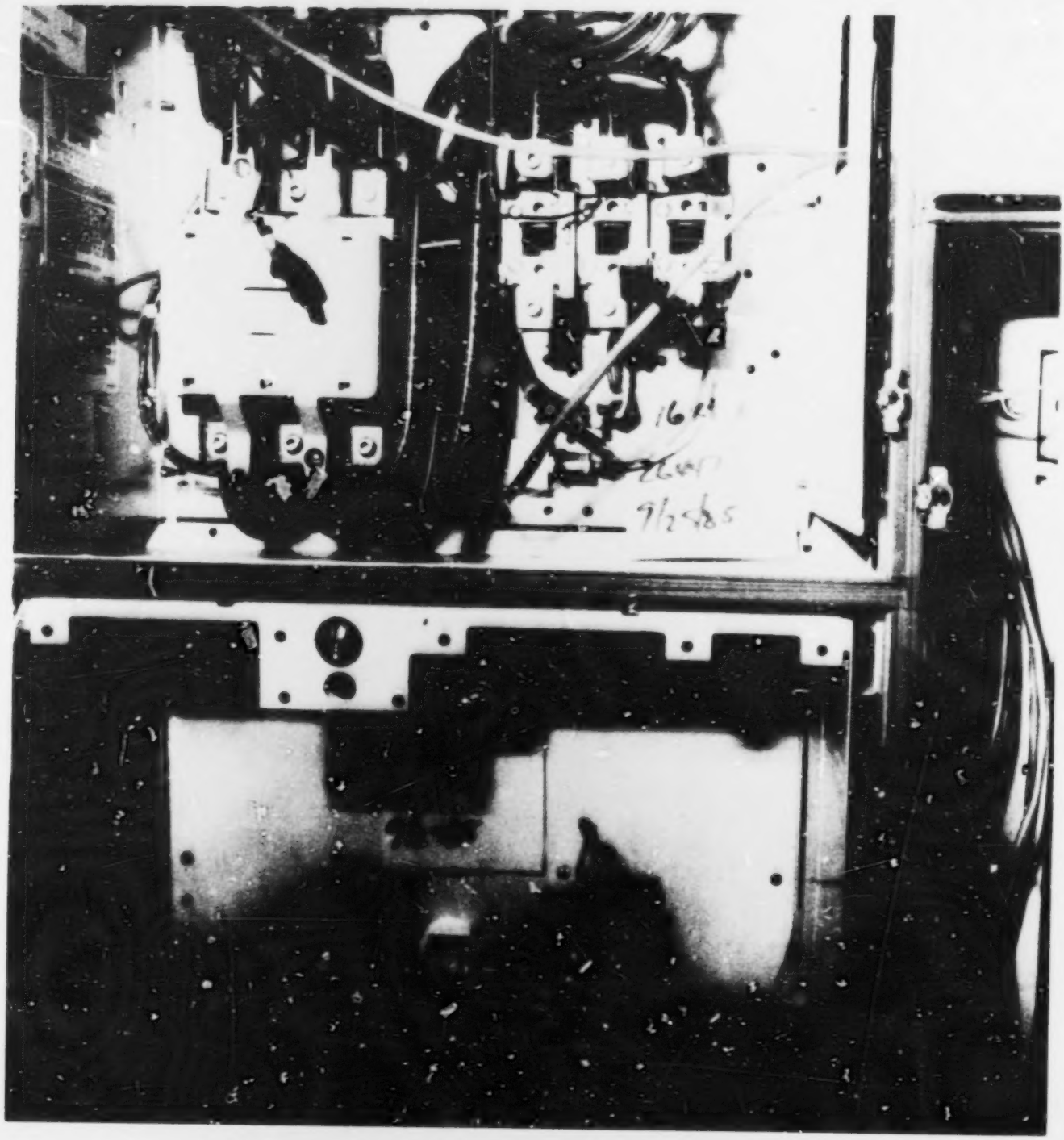

Fig. A-12. Detail of MCC compartment 3G (Westinghouse Size 4 FVNR controller).

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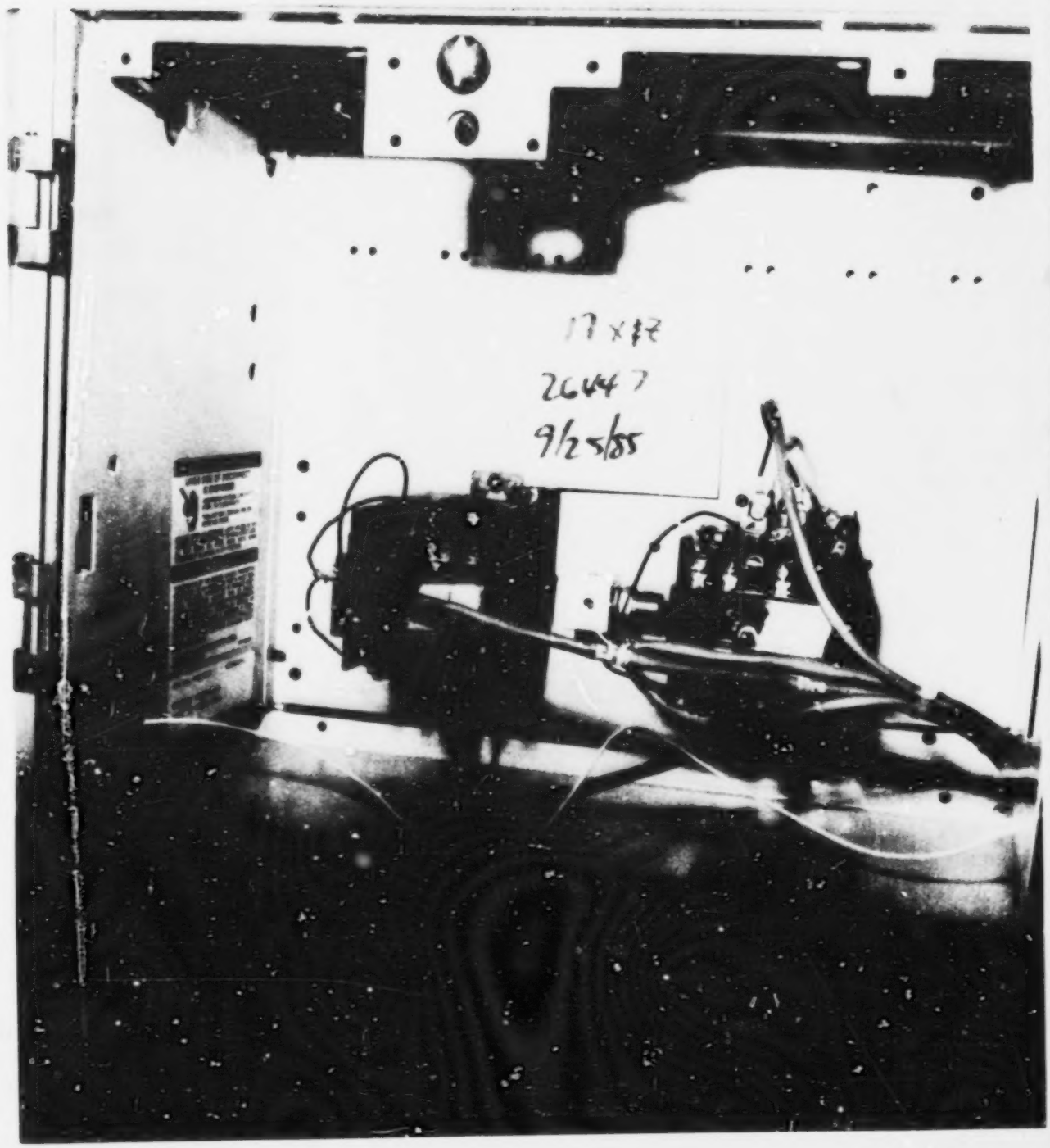

Fig. A-13. Detail of MCC compartment 3J (General Electric Type CR relays).

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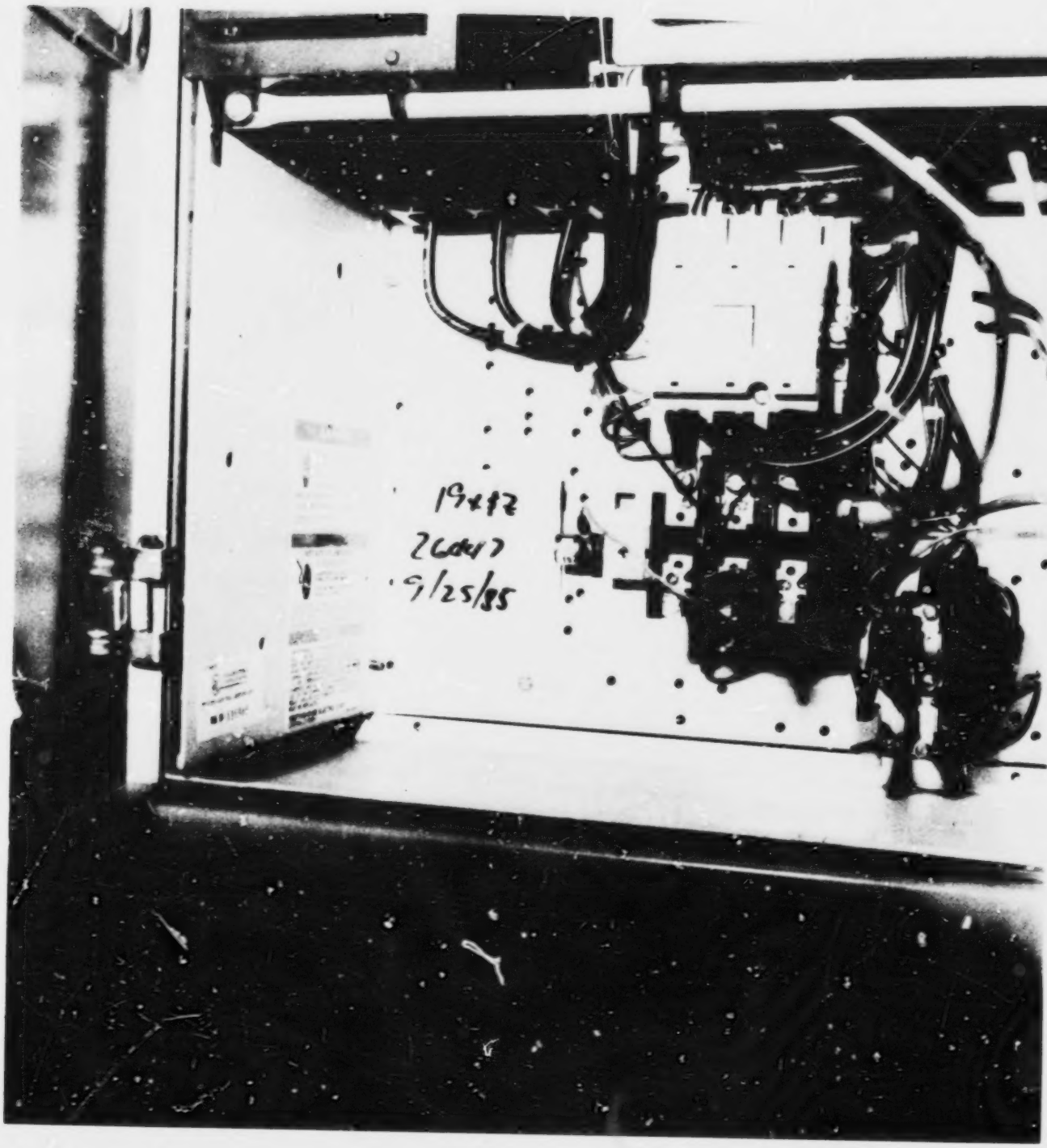

Fig. A-14. Detail of MCC compartment 3M (Westinghouse Size 2 FVR controller).

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APPENDIX B

Resonance Search Transmissibility Plots

RUN 2

Four bolts per column with top brace, vertical direction

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Report No. 26448

Page No. A-2

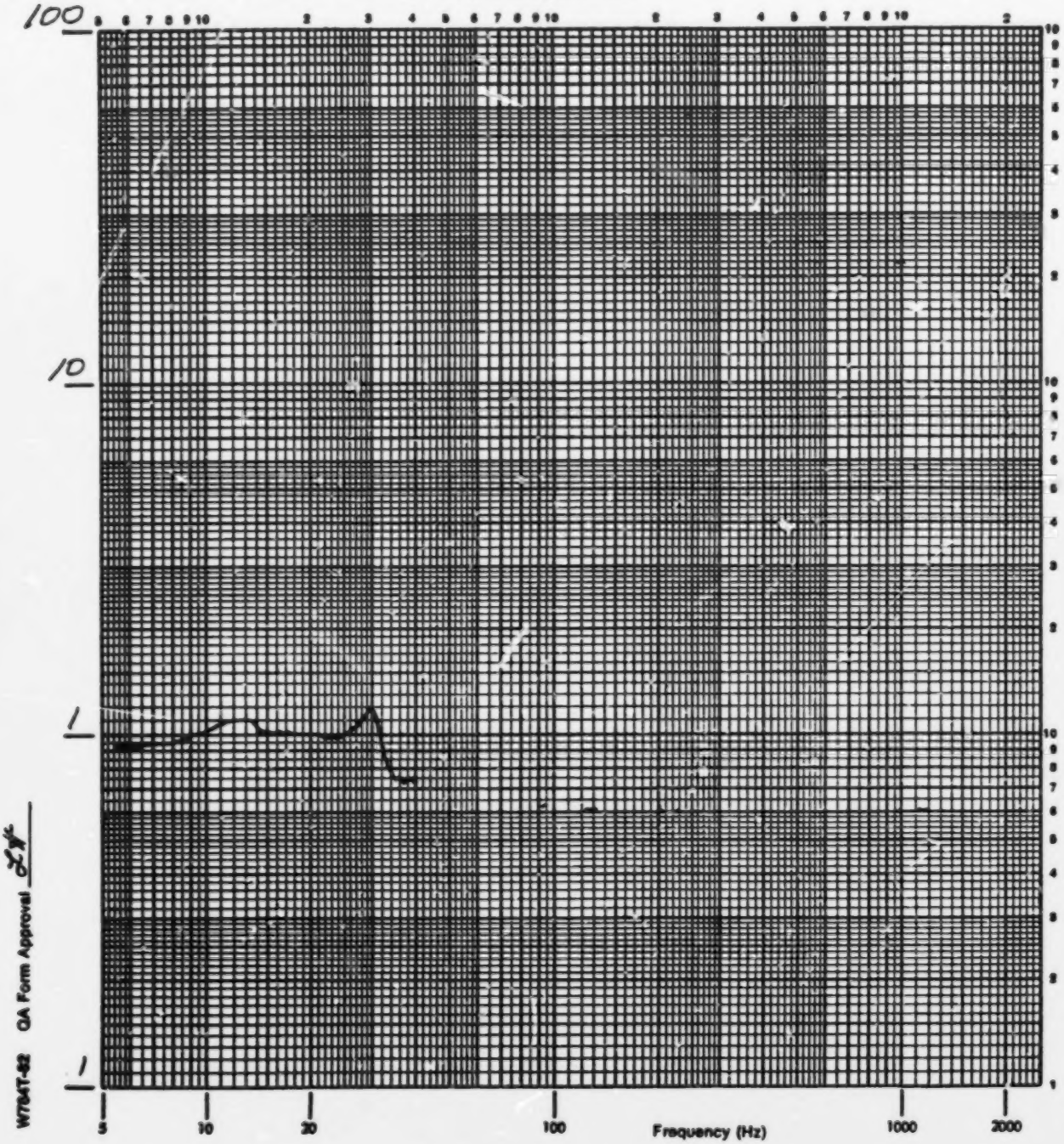
CUSTOMER L.L.N.L Job No. 26447 Date 9-25-85

Specimen MOTOR CONTROL UNIT Test Axis Y Accel. No. 3/2

Operator GREIERMAN Engineer Run Full Scale 100 0

RUN #2

TRANSMISSIBILITY



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CUSTOMER L.L.N.L Job No. 26447 Date 9-25-85

Specimen MOTOR CONTROL UNIT Test Axis Y Accel. No. 4/2

Operator GREENMAN Engineer [signature] Full Scale 100 G

RUN 2

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

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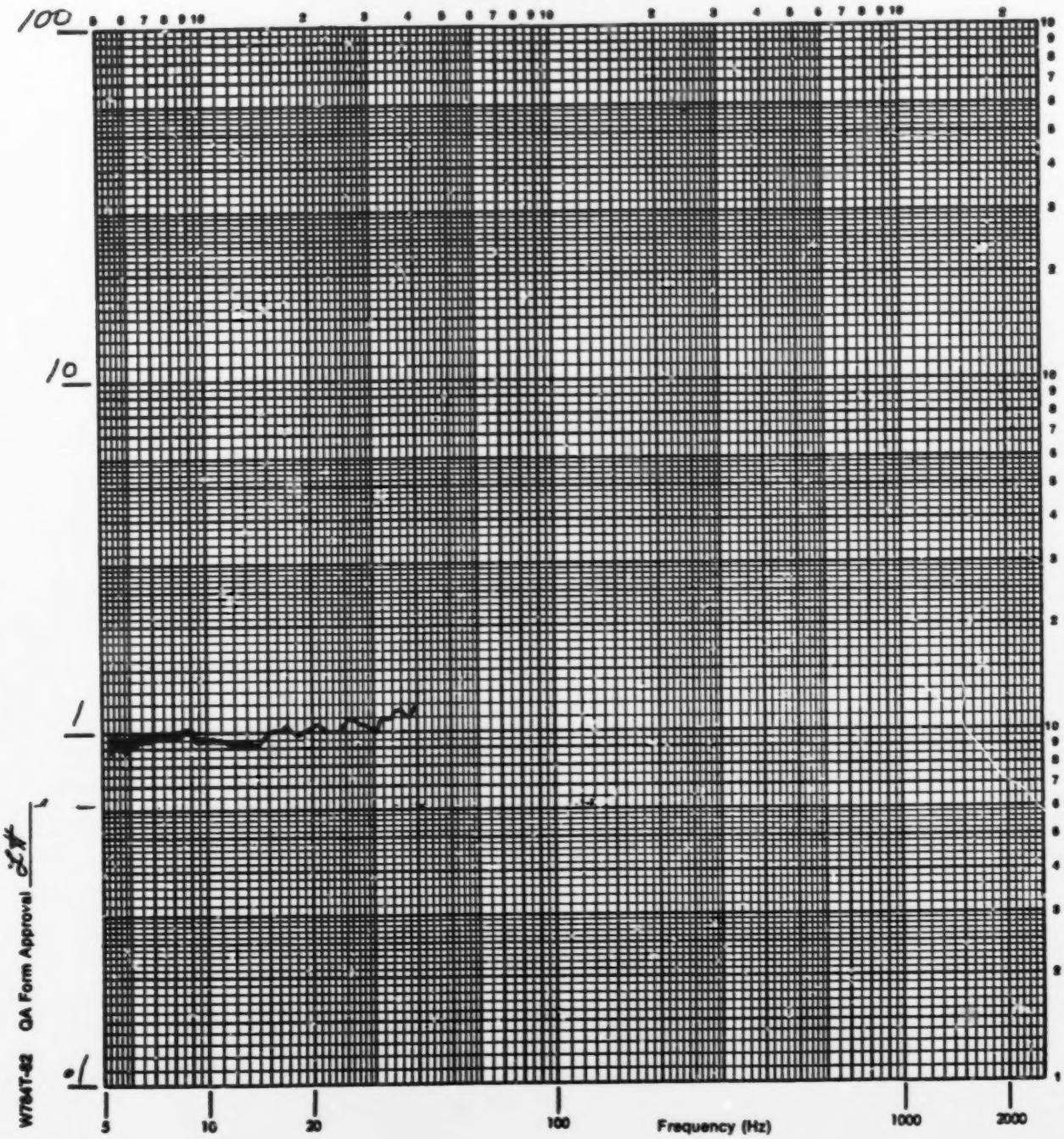
Specimen MOTOR CONTROL UNIT Test Axis Y Accel. No. 6/2

Operator GREIFFMAN Engineer Rm Full Scale 100 Q

RUN #2

TRANSMISSIBILITY



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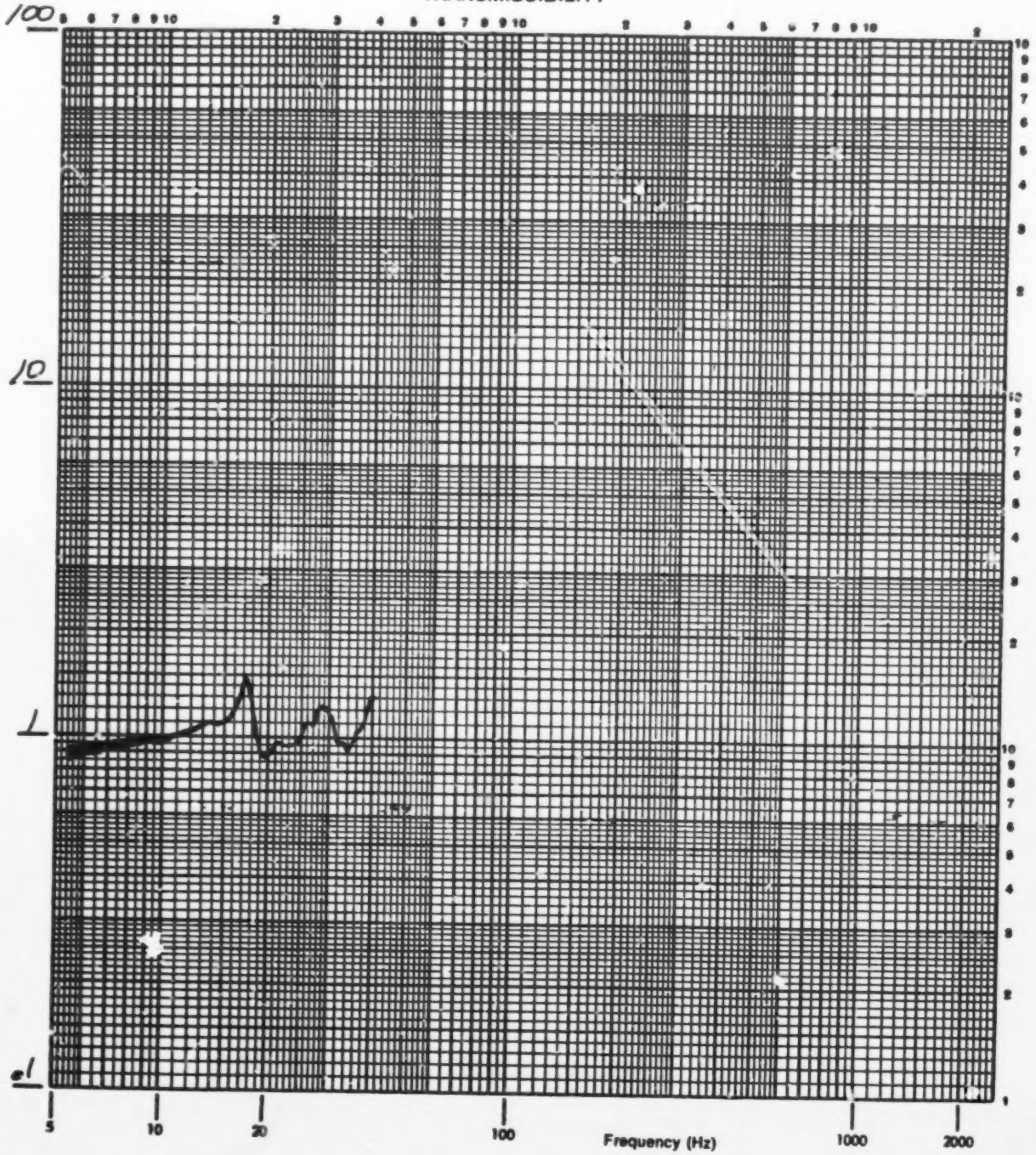
CUSTOMER L.L.N.L Job No. 26447 Date 9-25-85

Specimen MOTOR CONTROL UNIT Test Axis Y Accel. No. 12/2

Operator GREIERMAN Engineer RM Full Scale 100 Q

RUN 2

TRANSMISSIBILITY



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RUN 3

Four bolts per column with top brace, S-S direction

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Report No. 26448

Page No. A-6

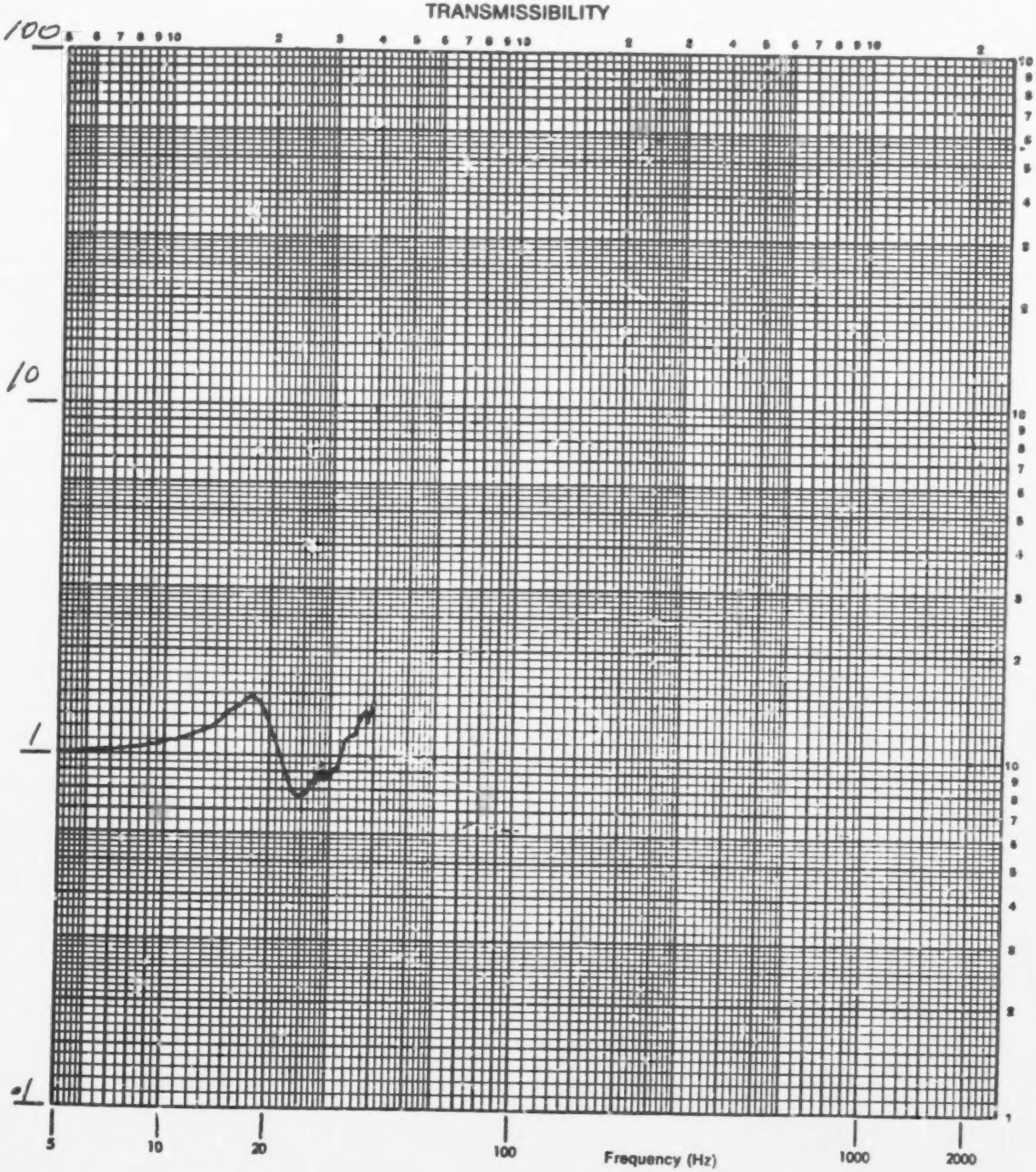
CUSTOMER L.L.N.L Job No. 26447 Date 9-25-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 3/1

Oporator GREIERMAN Engineer Bm Full Scale 100 Q

RUN 3

TRANSMISSIBILITY



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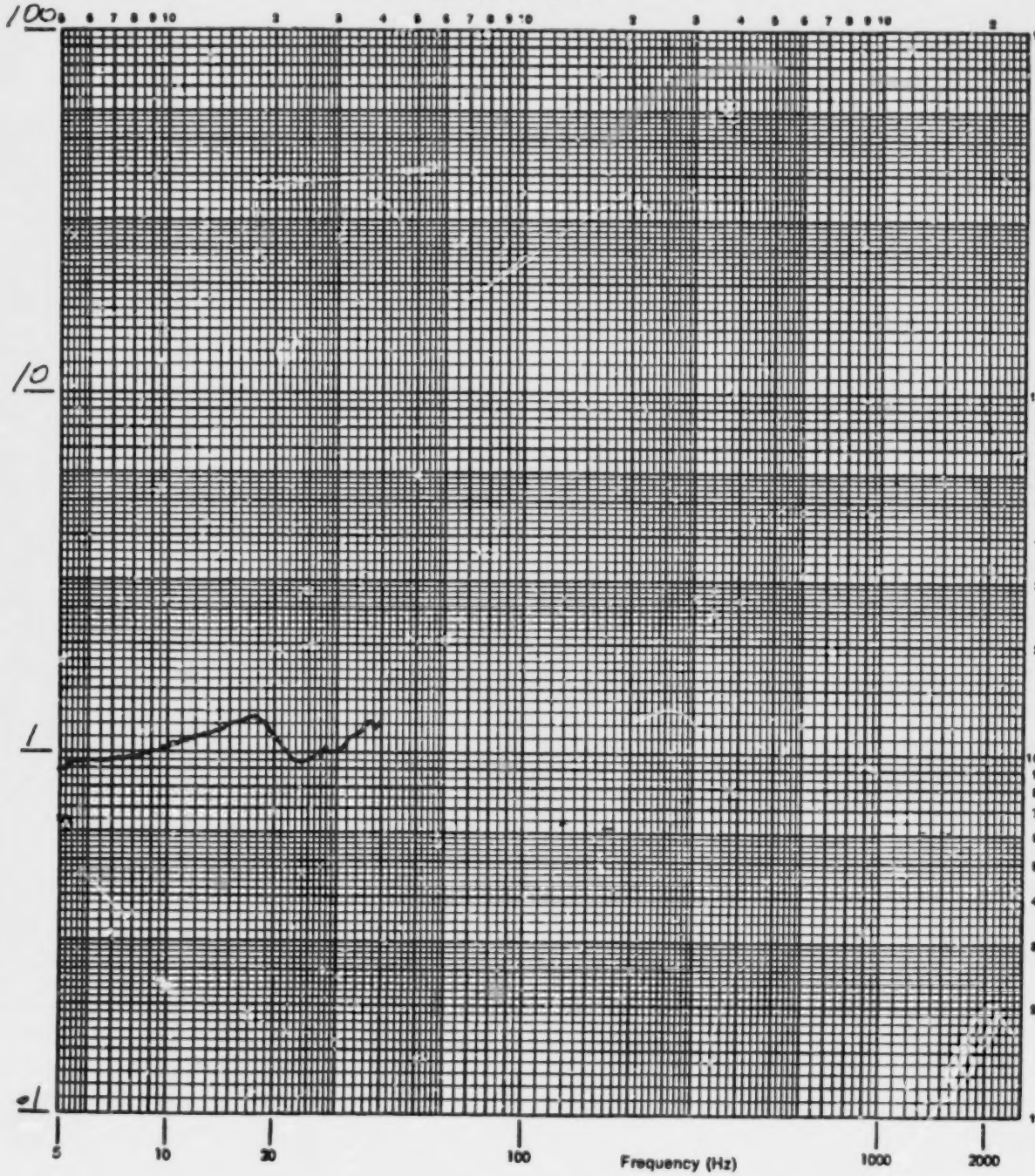
CUSTOMER L.L.N.L Job No. 26447 Date 9-25-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 4/1

Operator BEETERMAN Engineer [signature] Full Scale 100 G

RUN 3

TRANSMISSIBILITY



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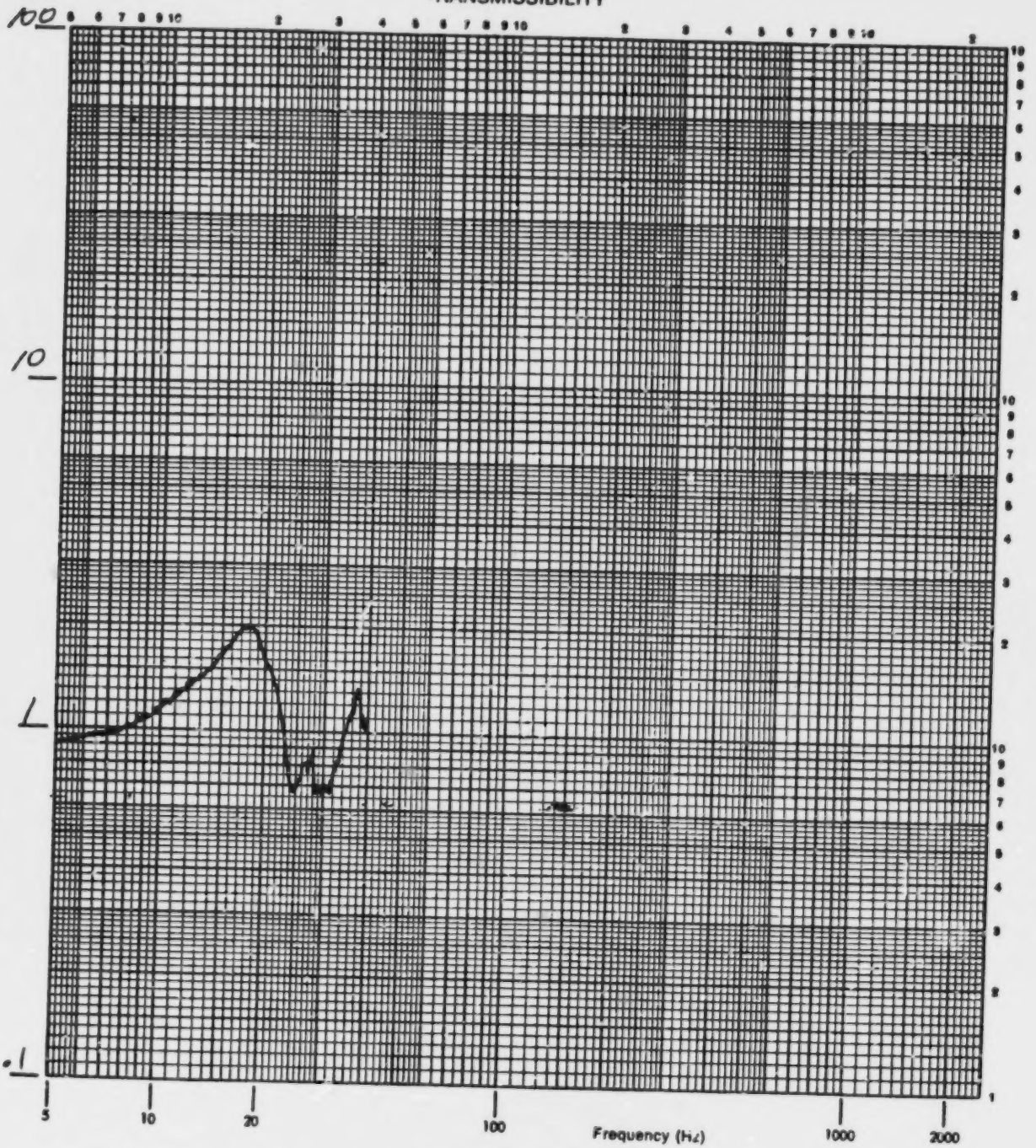
CUSTOMER L.L.N.L Job No. 26447 Date 9-25-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 5/1

Operator GRETERMAN Engineer [signature] Full Scale 100 G

RUN 3

TRANSMISSIBILITY



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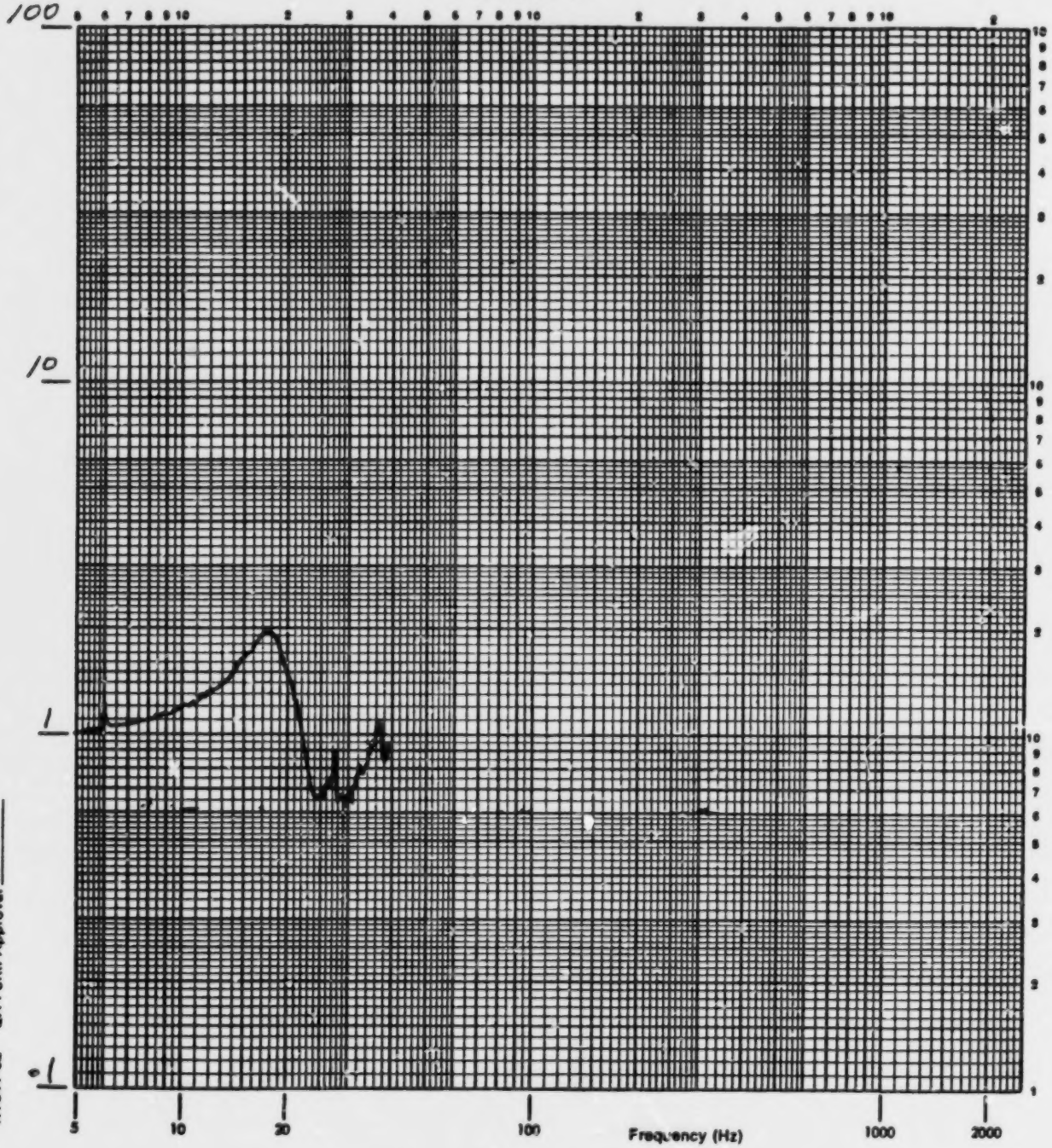
Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 7/1

Operator GREENMAN Engineer [signature] Full Scale 100 G

RUN 3

TRANSMISSIBILITY



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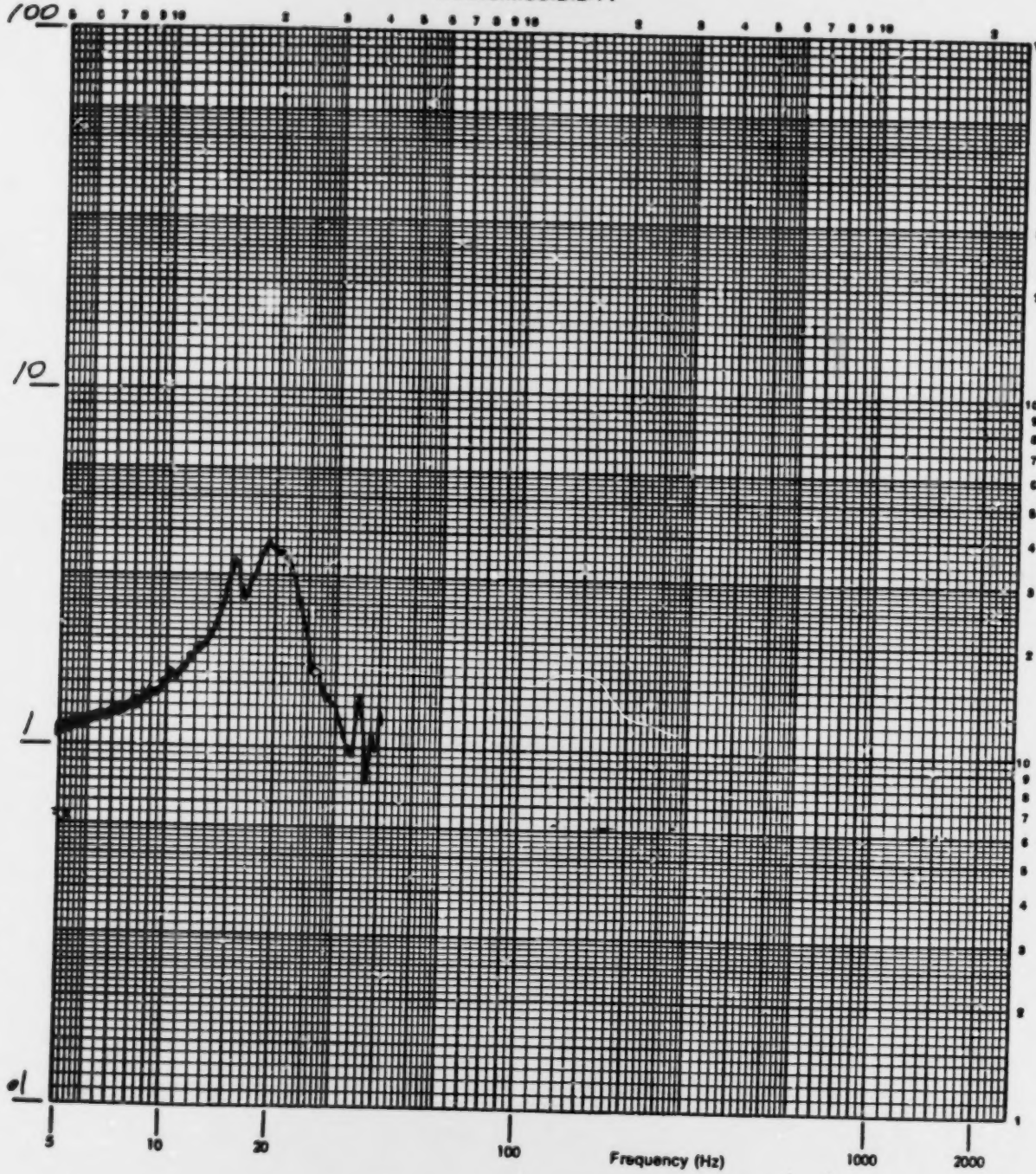
Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 8/1

Operator GREENBERMAN Engineer Rm Full Scale 100 G

RUN 3

TRANSMISSIBILITY



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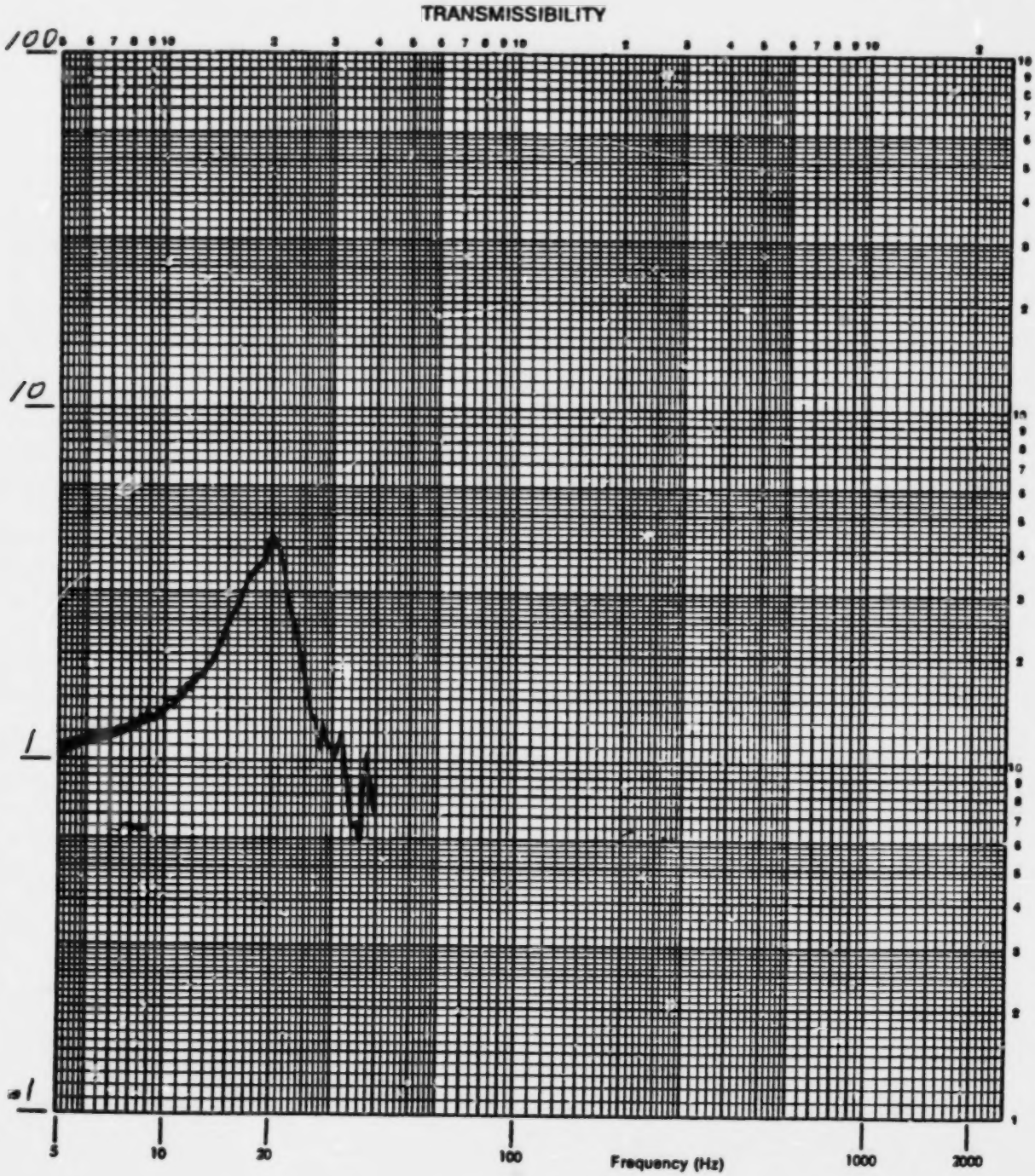
Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 9/1

Operator GREENERMAN Engineer [signature] Full Scale 100 G

RUN 3



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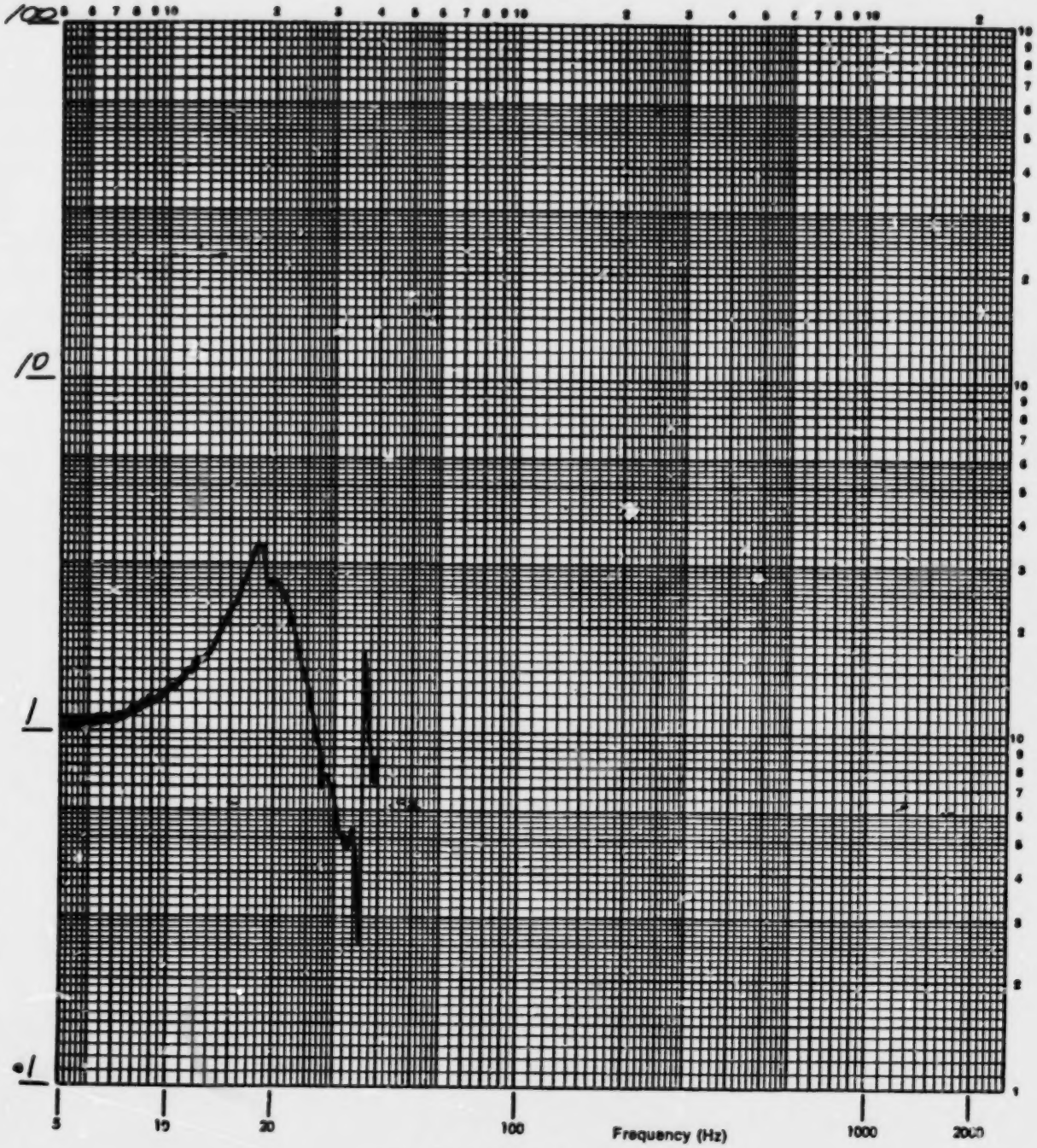
CUSTOMER L.L.N.L Job No. 26447 Date 9-25-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 10/1

Operator GREENMAN Engineer Run Full Scale 100 Q

RUN 3

TRANSMISSIBILITY



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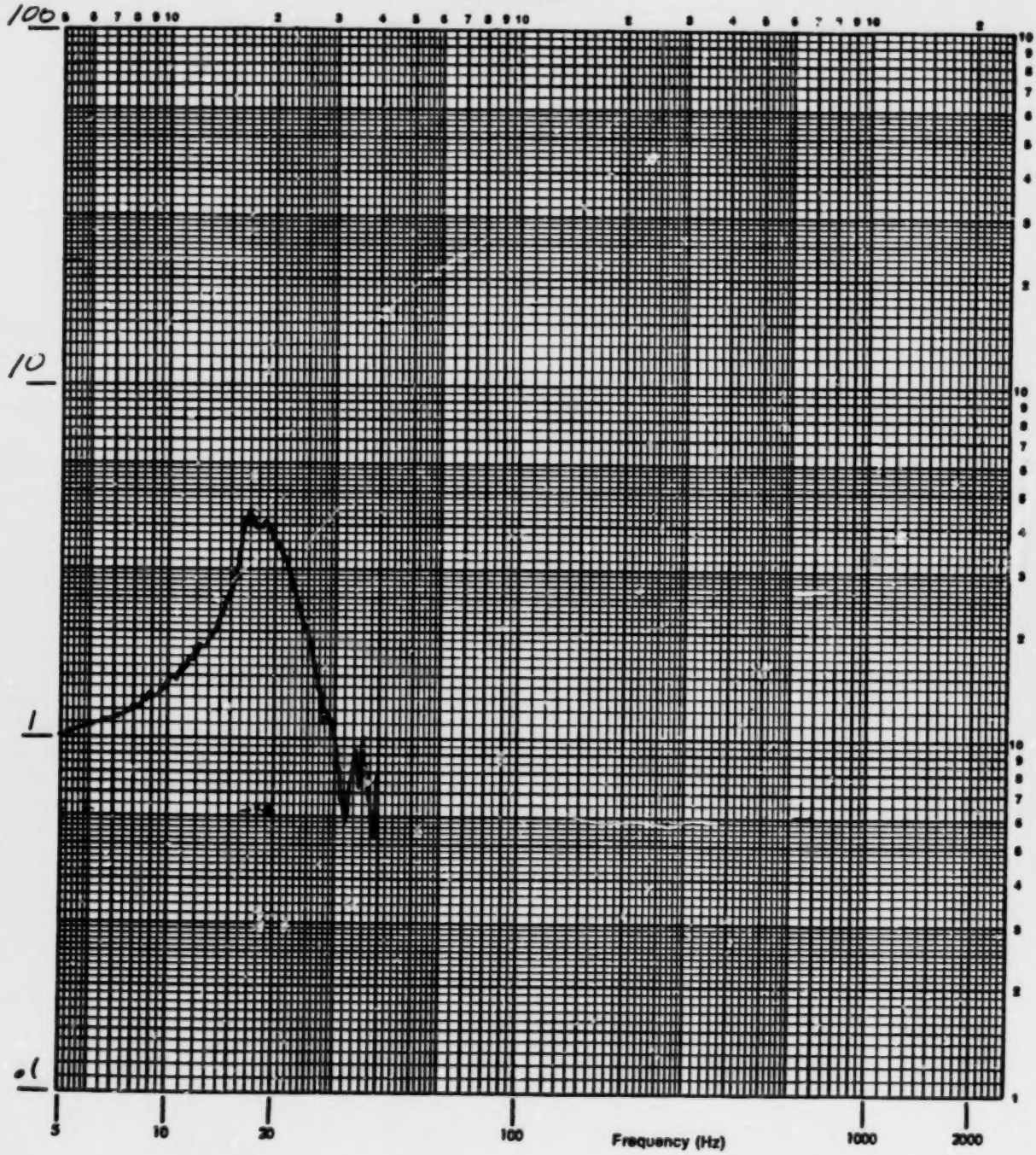
Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 11/1

Operator GREIERMAN Engineer Rm Full Scale 100 G

RUN 3

TRANSMISSIBILITY



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Page No. A-14

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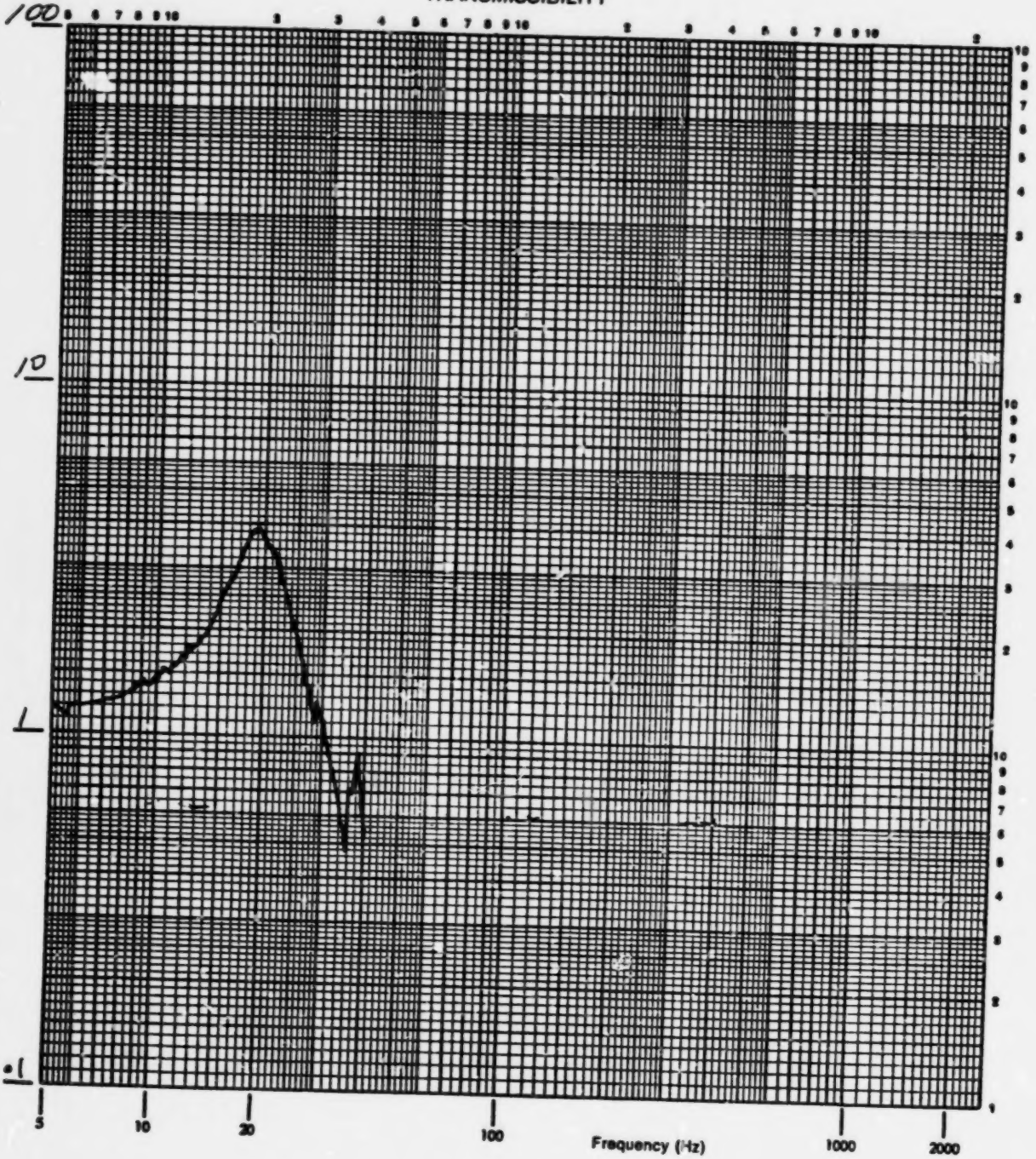
Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 13/1

Operator GREENMAN Engineer [signature] Full Scale 100 G

RUN 3

TRANSMISSIBILITY



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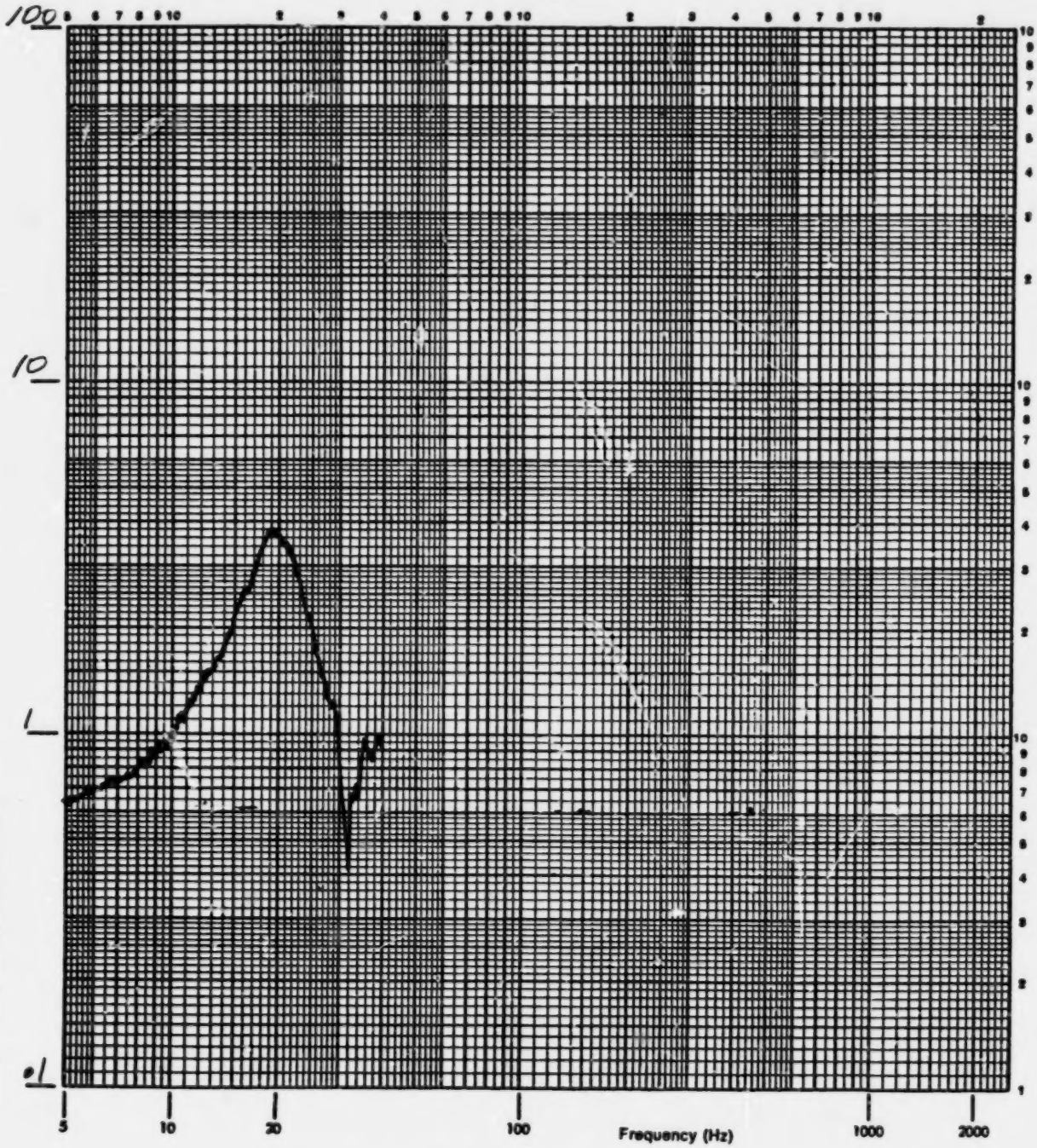
CUSTOMER L.L.N.L Job No. 26447 Date 9-25-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 14/1

Operator GREENMAN Engineer [signature] Full Scale 100 G

RUN 3

TRANSMISSIBILITY



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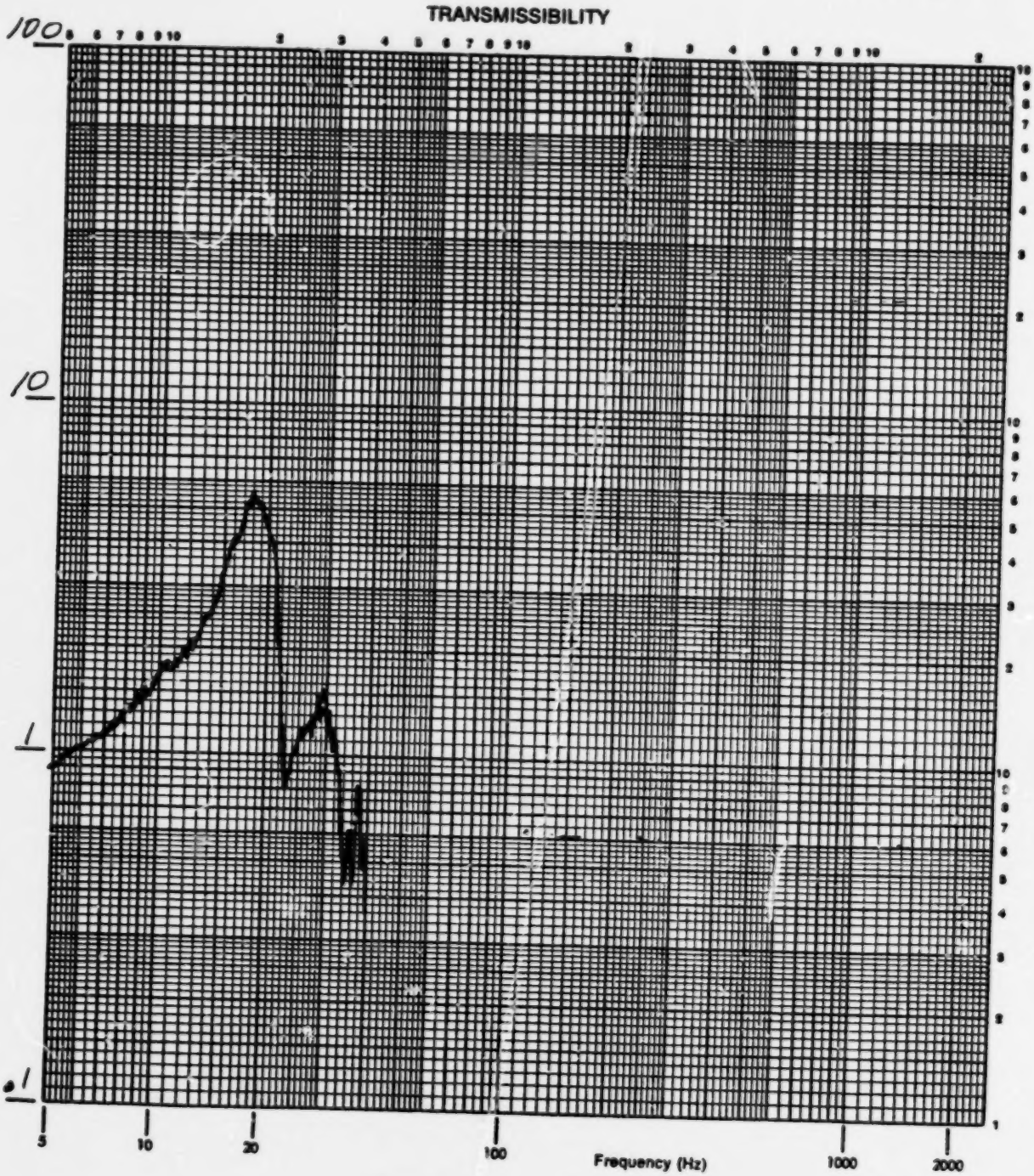
Page No. A-16

CUSTOMER L.L.N.L Job No. 26447 Date 9-25-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 15/1

Operator BRETERMAN Engineer [signature] Full Scale 100 Q

RUN 3



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Page No. A-17

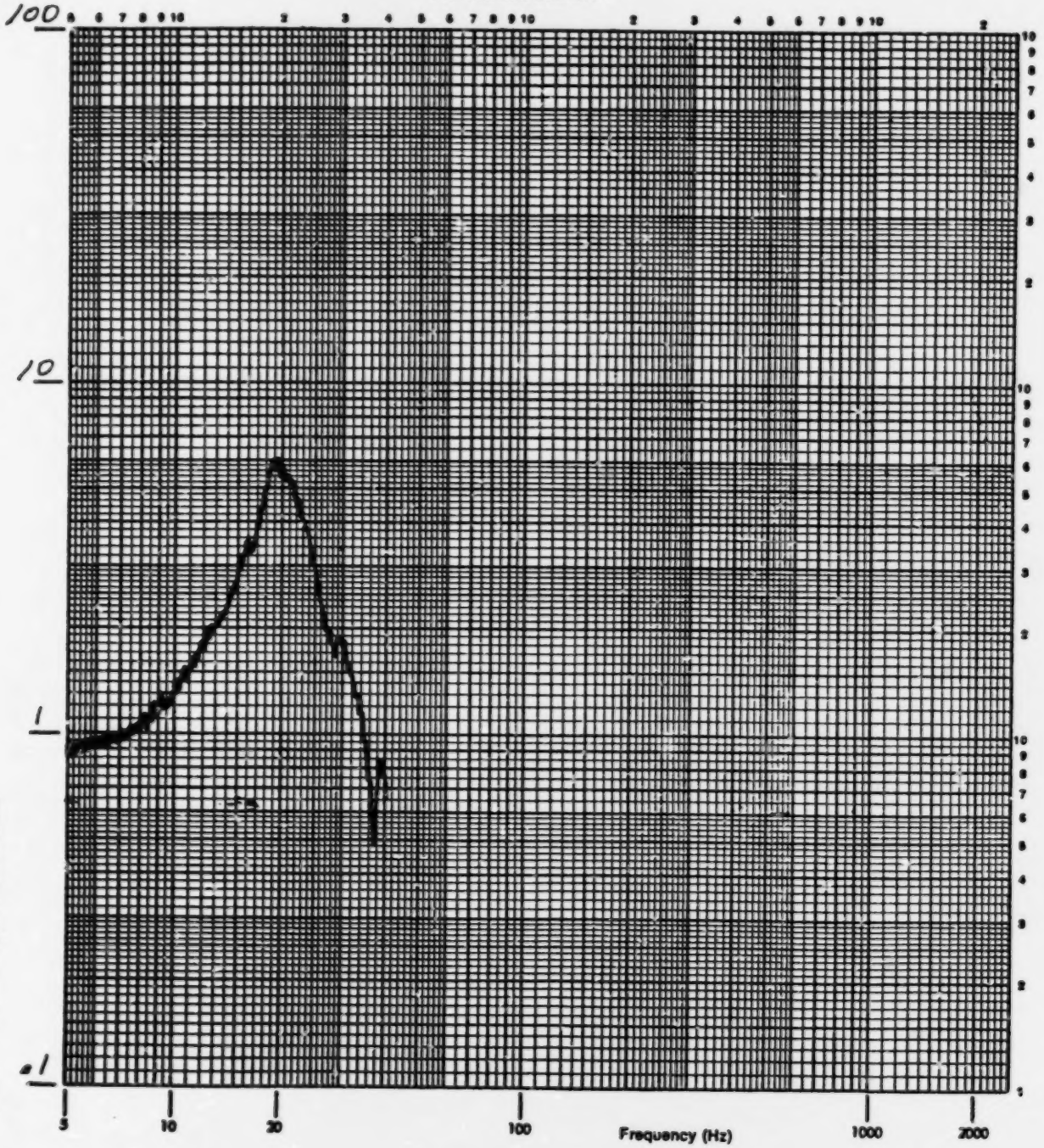
CUSTOMER L.L.N.L. Job No. 26447 Date 9-25-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 16/1

Operato GREENMAN Engineer RMM Full Scale 100 G

RUN 3

TRANSMISSIBILITY



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Report No. 26448

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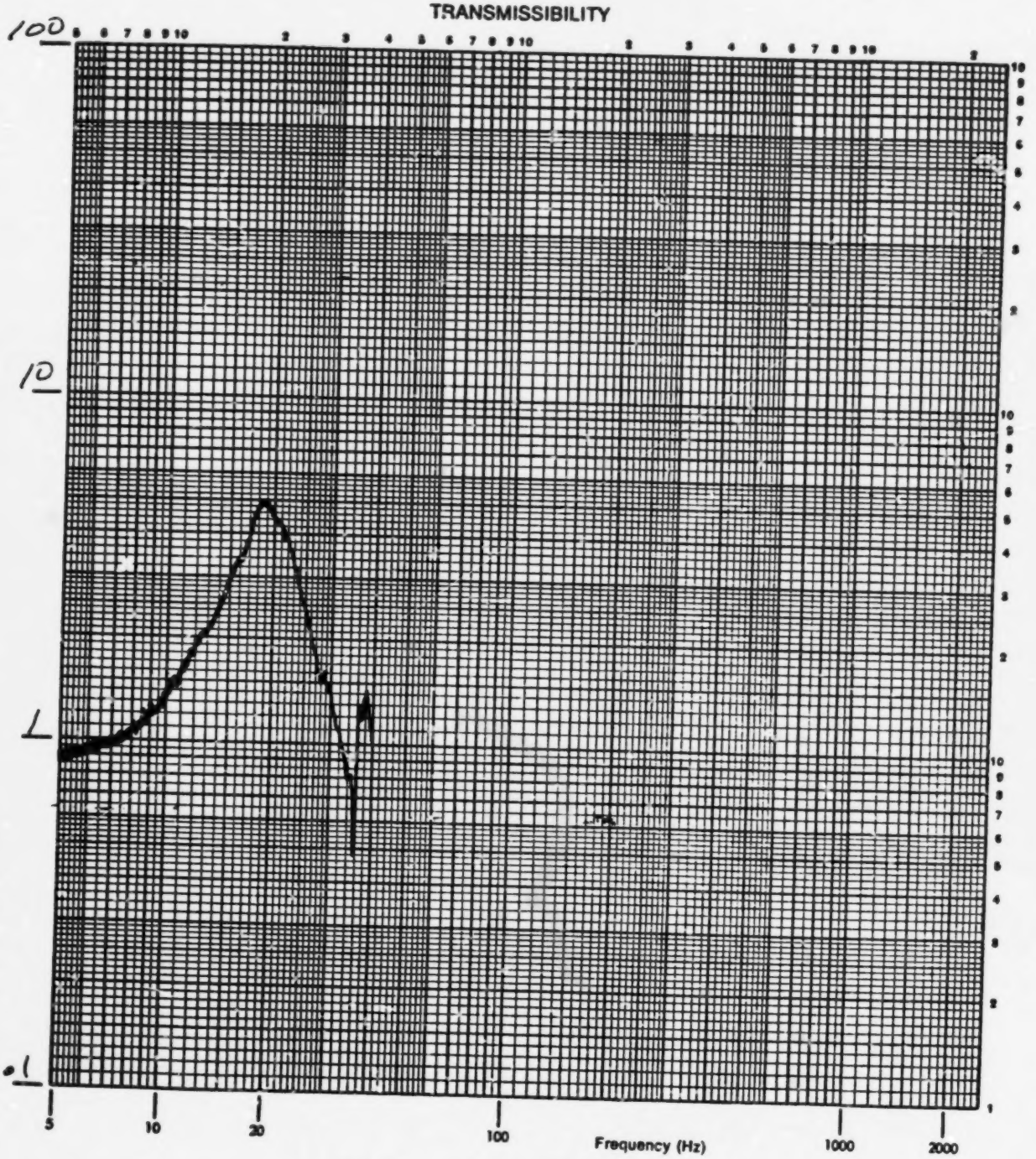
CUSTOMER L.L.N.L Job No. 26447 Date 9-25-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 17/1

Operator GREENMAN Engineer Rum Full Scale 100 G

RUN 3

TRANSMISSIBILITY



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Report No. 26448

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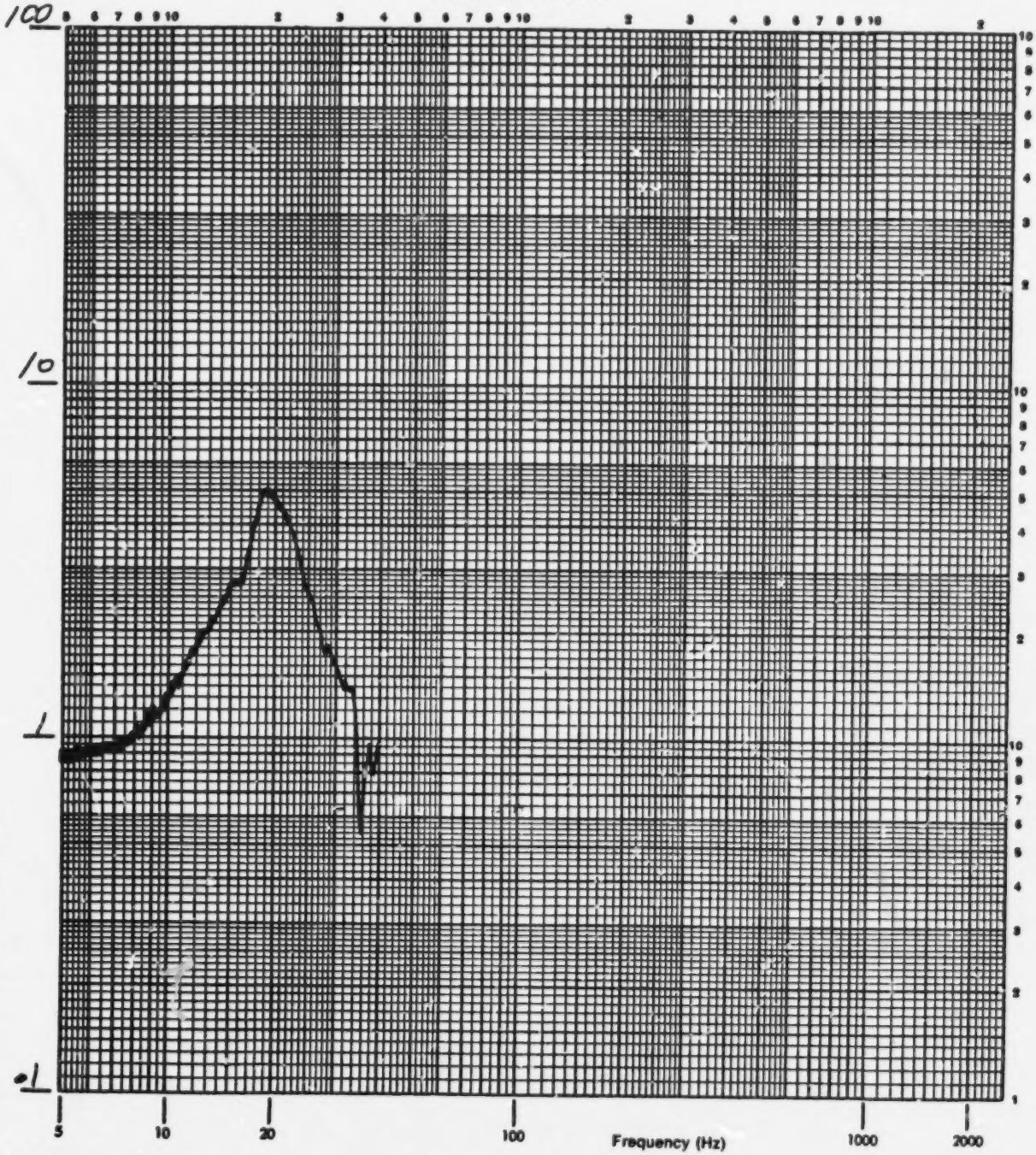
CUSTOMER L.L.N.L. Job No. 26447 Date 9-25-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 18/1

Operator GREENMAN Engineer Run Full Scale 100 G

RUN 3

TRANSMISSIBILITY



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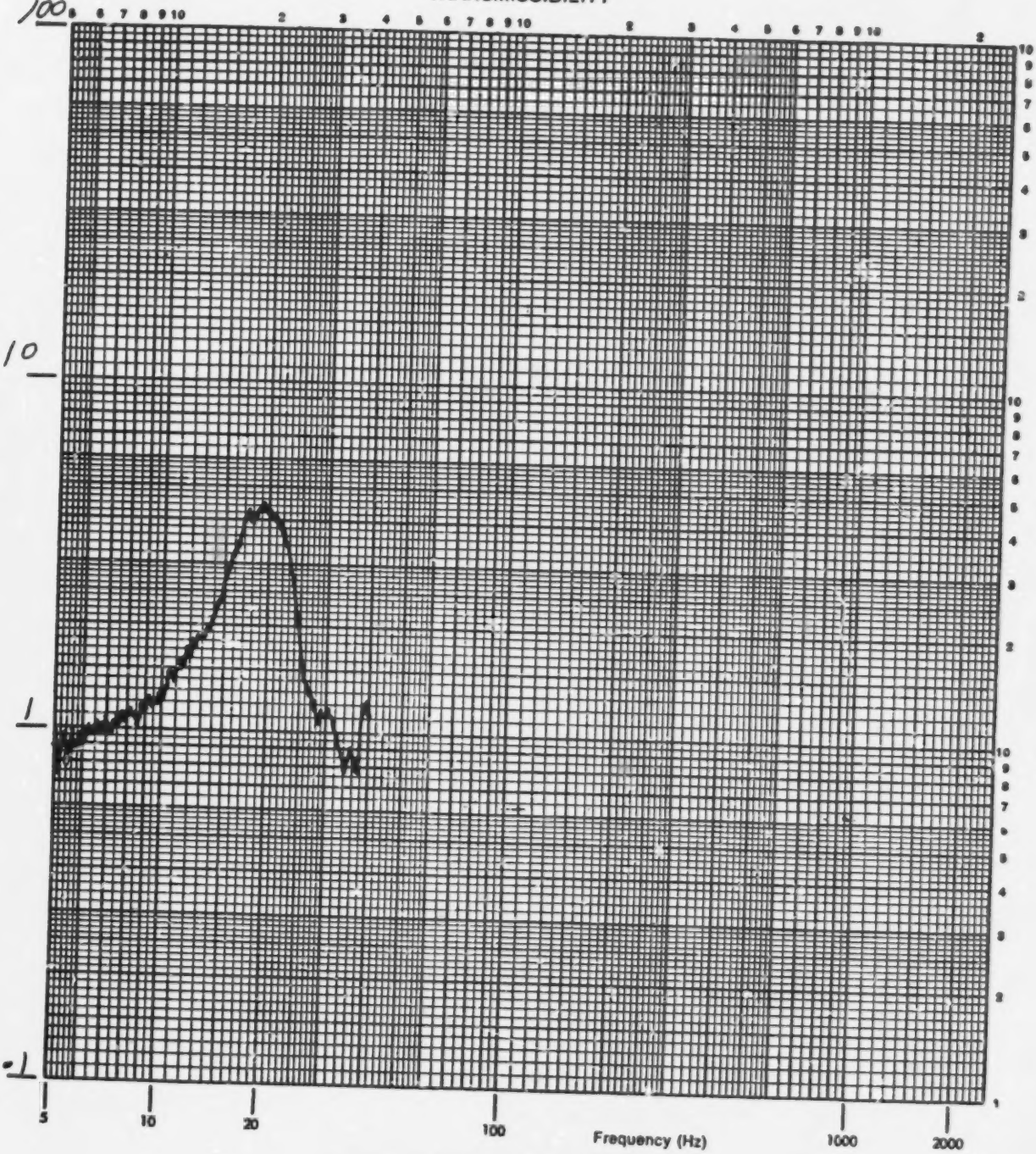
CUSTOMER L.L.N.L Job No. 26447 Date 9-25-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 19/1

Operator GREENMAN Engineer Rum Full Scale 100

RUN 3

TRANSMISSIBILITY



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RUN 11

Four bolts per column with top brace, F-B direction

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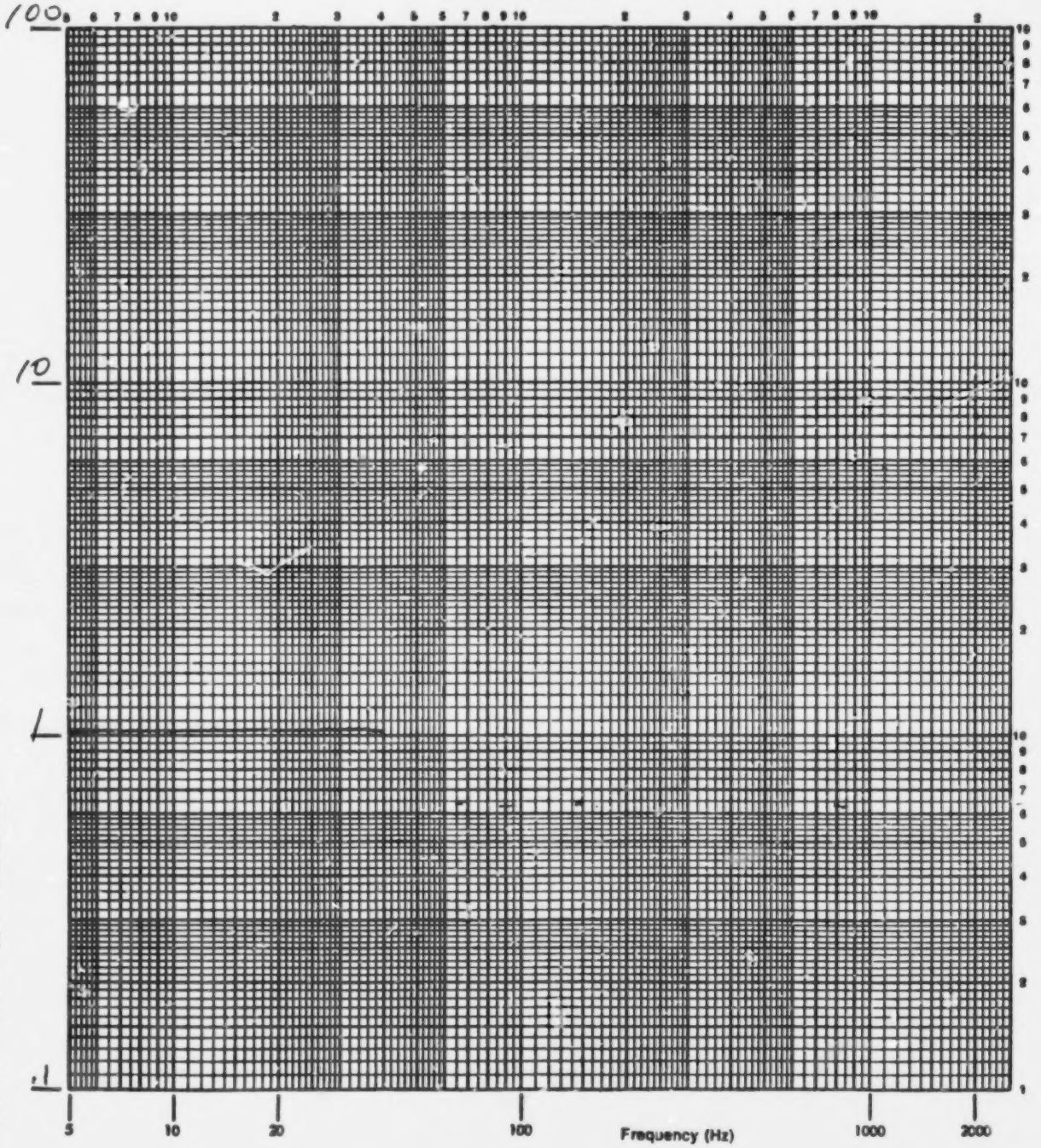
CUSTOMER L.L.N.L Job No. 26447 Date 10-2-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 3/1

Operator GREENMAN Engineer [signature] Full Scale 100 G

RUN # 11

TRANSMISSIBILITY



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Report No. 26448

CUSTOMER L.L.N.L Job No. 26447 Date 10-2-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 4/1

Operator GREENMAN Engineer [signature] Full Scale 100 G

RUN # 11

TRANSMISSIBILITY

100

10

1

.1

5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2

10 9 8 7 6 5 4 3 2 1

5 10 20 100 Frequency (Hz) 1000 2000

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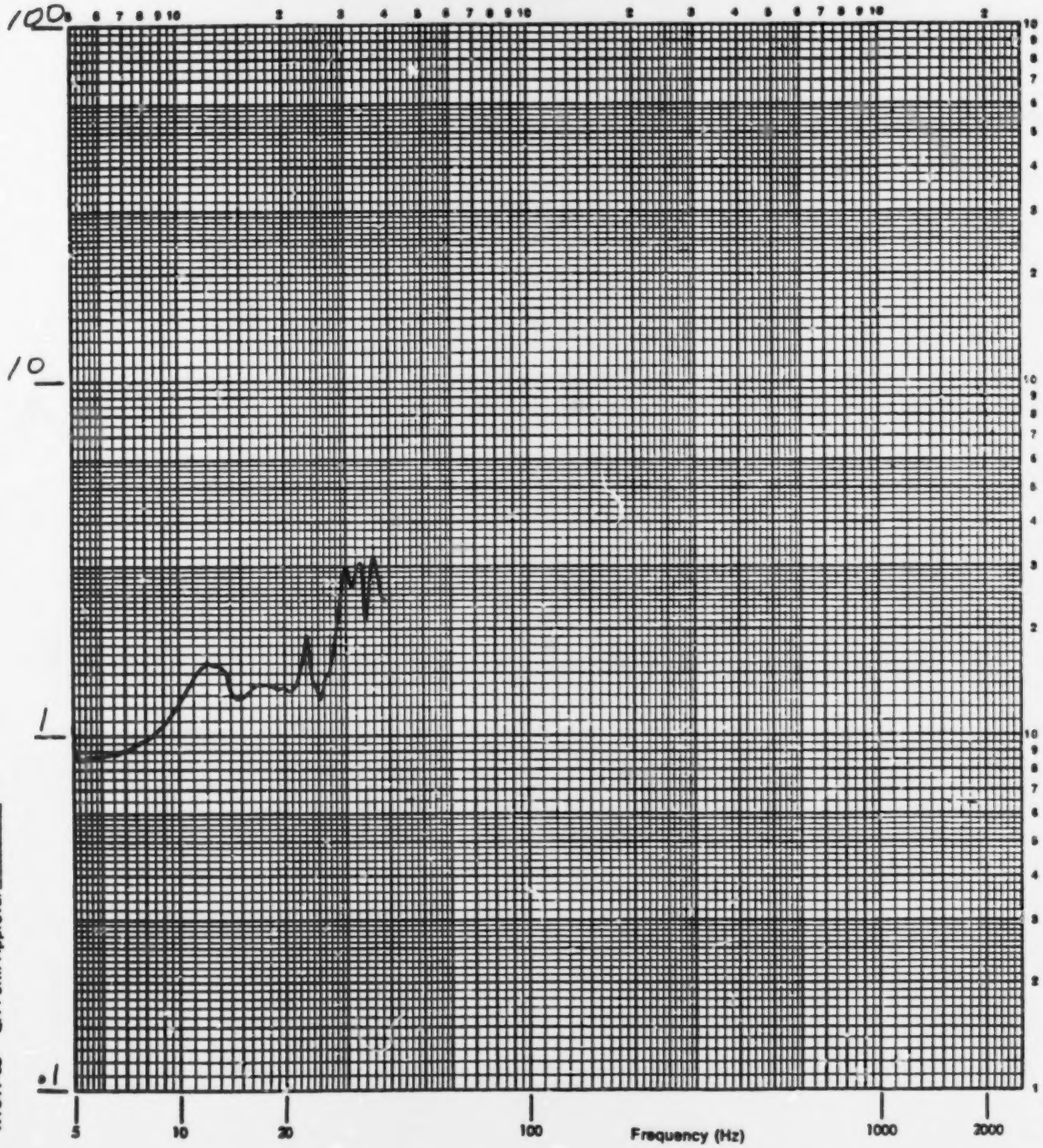
CUSTOMER L.L.N.L Job No. 26447 Date 10-2-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 5/1

Operator GEETERMAN Engineer [signature] Full Scale 100 G

Run # 11

TRANSMISSIBILITY



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Report No. 26448

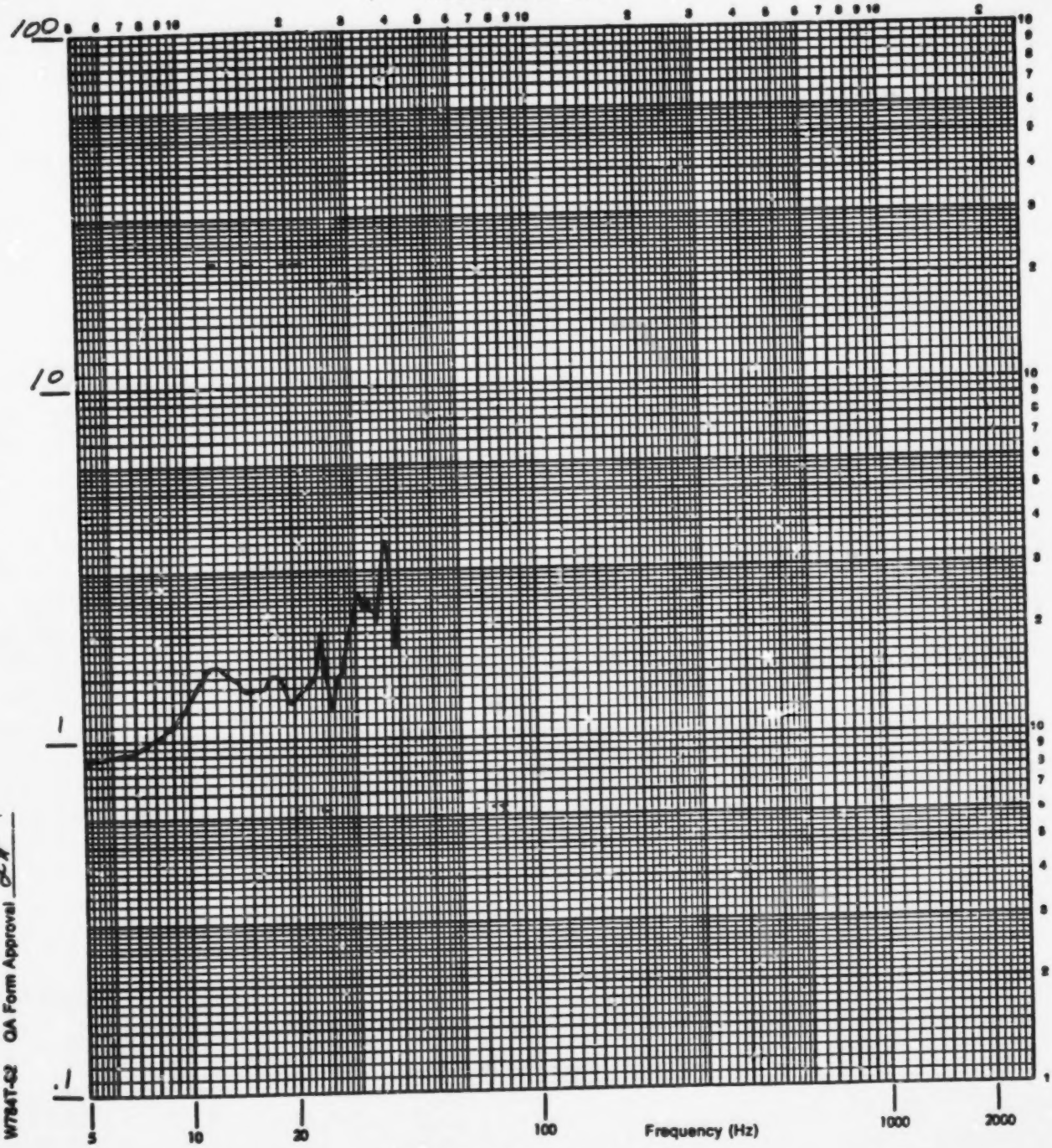
CUSTOMER L.L.N.L. Job No. 26447 Date 10-2-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 7/1

Operator GRETERMAN Engineer BM Full Scale 100 G

RUN # 11

TRANSMISSIBILITY



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CUSTOMER L.L.N.L Job No. 26447 Date 10-2-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 8/1

Operator GRETERMAN Engineer [signature] Full Scale 100 G

RUN # 11

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

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CUSTOMER L.L.N.L Job No. 26447 Date 10-2-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 9/1

Operator GREENMAN Engineer _____ Full Scale 100 G

RUN # 11

TRANSMISSIBILITY

100

10

1

.1

5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2

10 9 8 7 6 5 4 3 2 1

5 10 20 100 1000 2000

Frequency (Hz)

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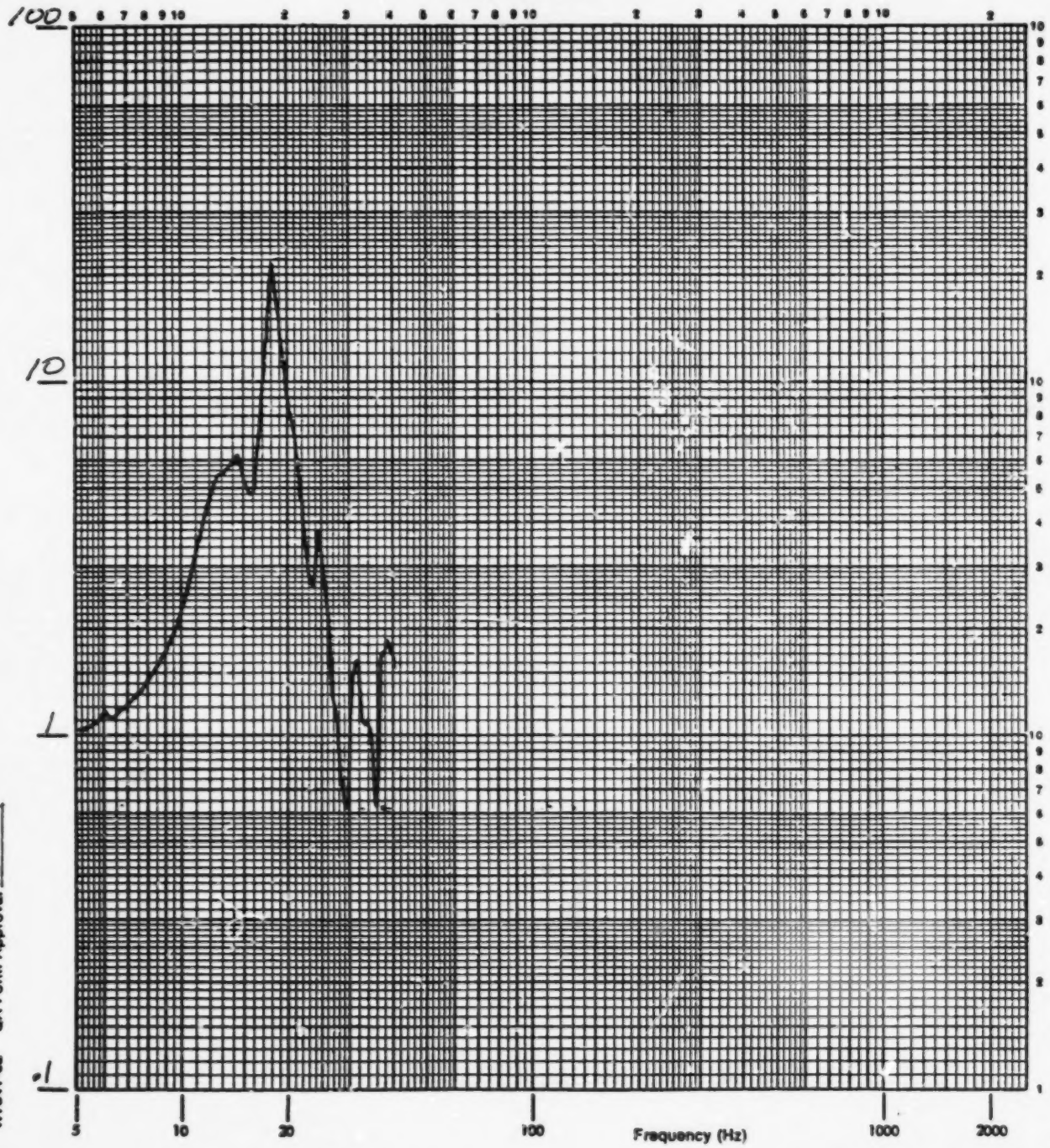
CUSTOMER L.L.N.L. Job No. 26447 Date 10-2-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 10/1

Operator GREIERMAN Engineer [signature] Full Scale 100 G

Run # 11

TRANSMISSIBILITY



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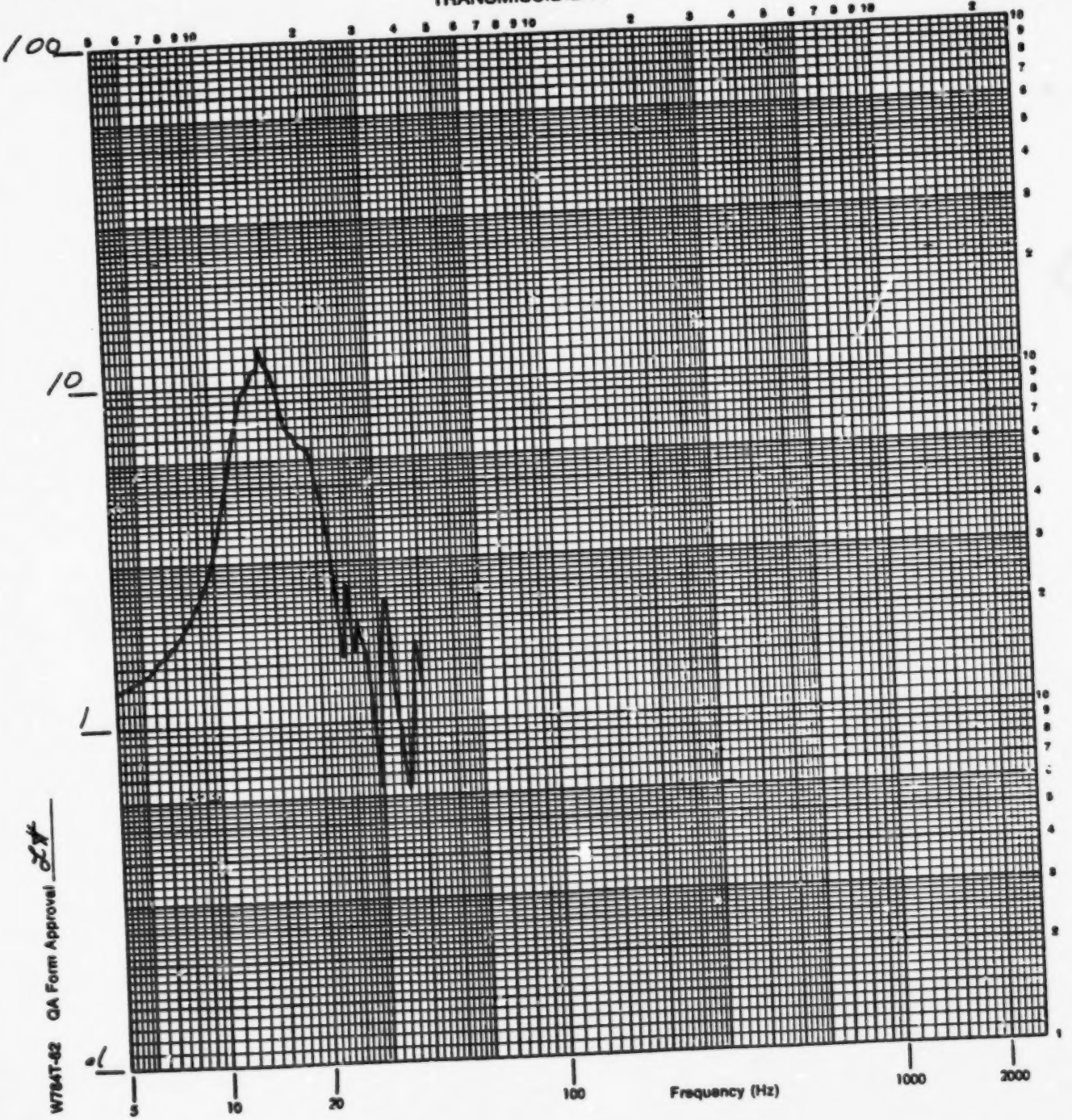
CUSTOMER L.L.N.L Job No. 26447 Date 10-2-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 11/1

Operator GREIERMAN Engineer Full Scale 100 G

RUN # 11

TRANSMISSIBILITY



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CUSTOMER L.L.N.L Job No. 26447 Date 10-2-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 13/1

Operator GREIERMAN Engineer [signature] Full Scale 100 G

ARR # 11

TRANSMISSIBILITY

100

10

1

.1

5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2

10 9 8 7 6 5 4 3 2 1

5 10 20 100 Frequency (Hz) 1000 2000

W7847-02 QA Form Approval [signature]

48

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CUSTOMER L.L.N.L Job No. 26447 Date 10-2-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 14/1

Operator GREIERMAN Engineer [signature] Full Scale 100 G

RUN # 11

TRANSMISSIBILITY

100

10

1

.1

Frequency (Hz)

5 10 20 100 1000 2000

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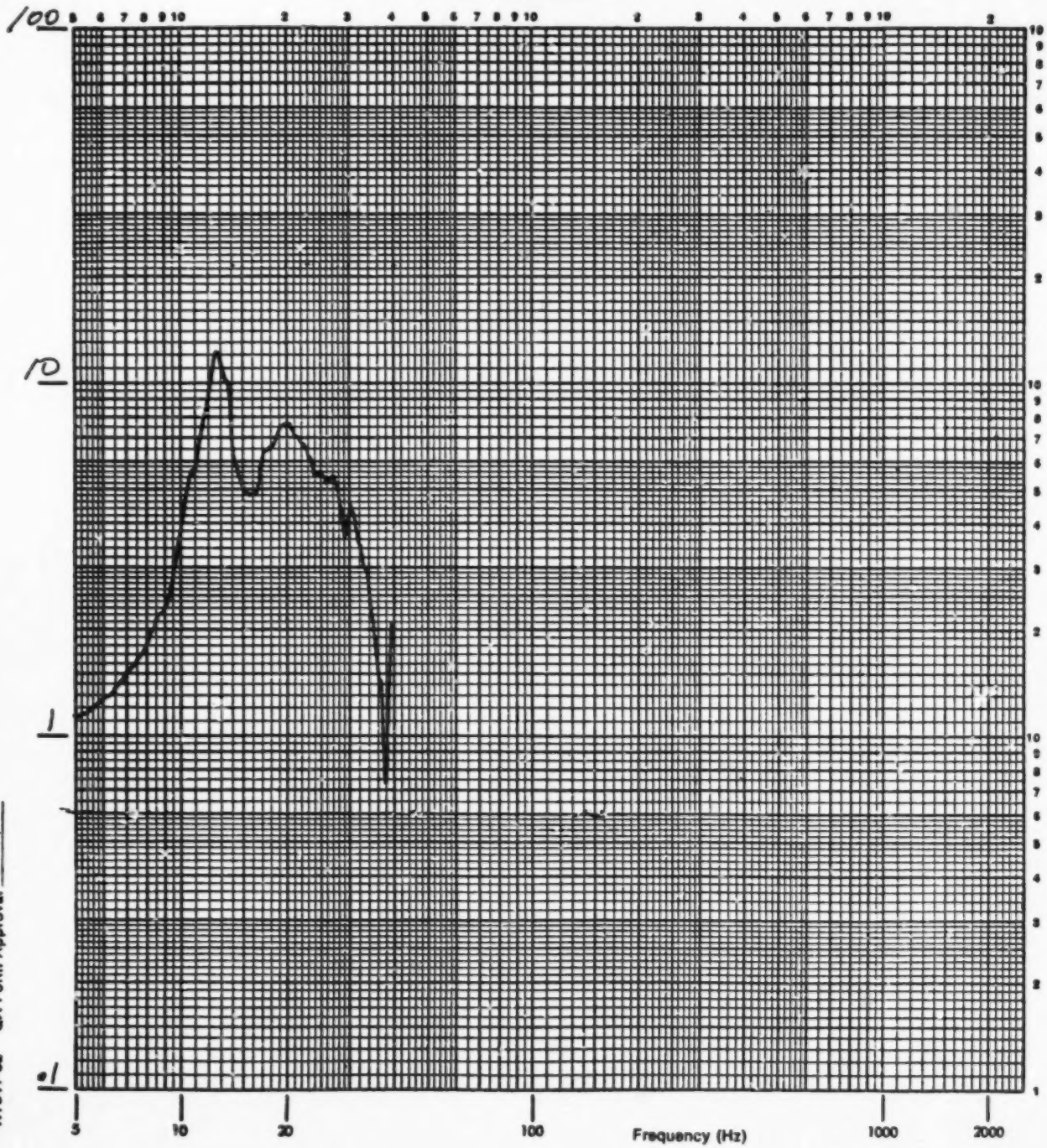
CUSTOMER L.L.N.L. Job No. 26447 Date 10-2-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 15/1

Operator GREIERMAN Engineer _____ Full Scale 100 G

RUN # 11

TRANSMISSIBILITY



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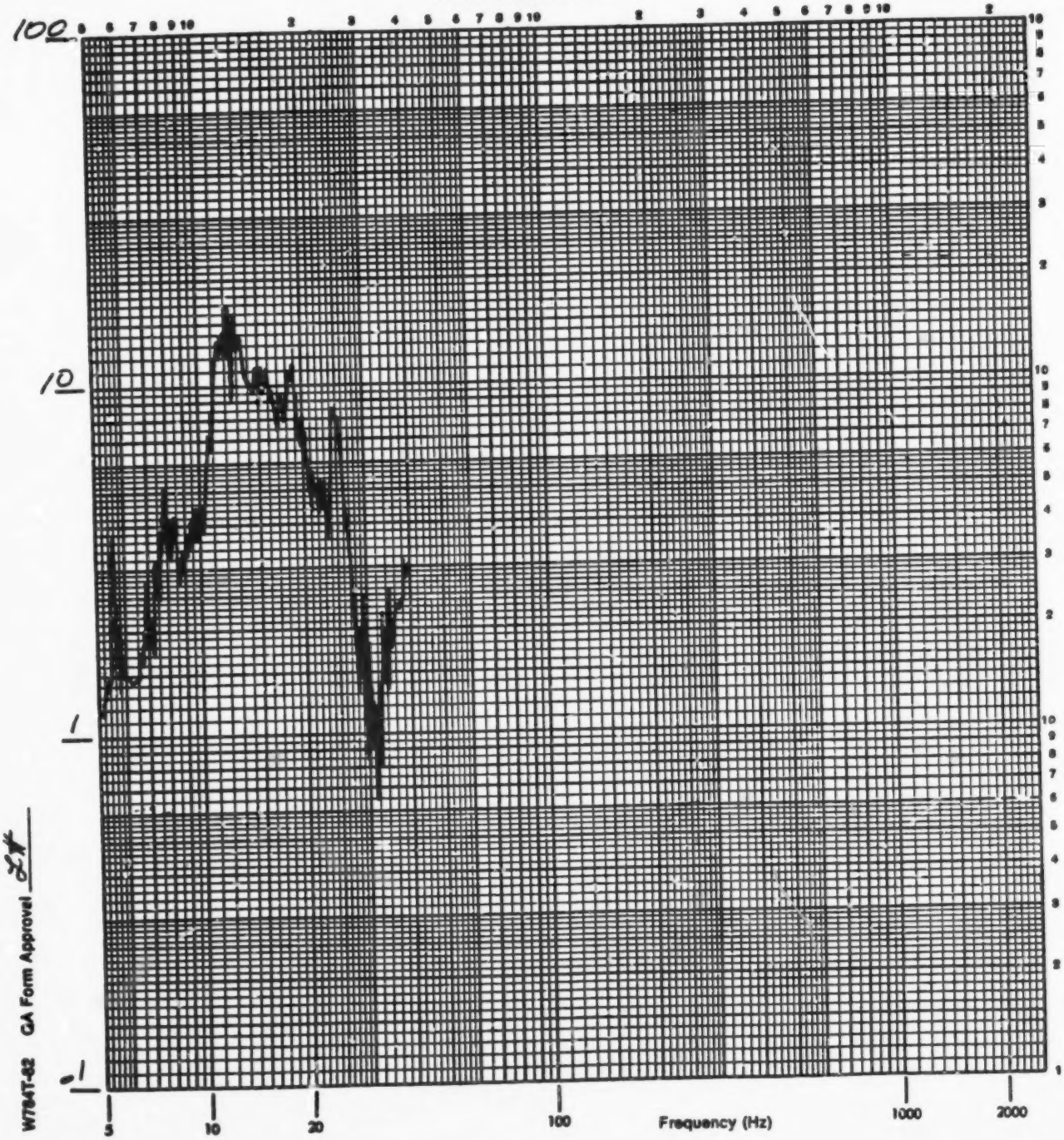
CUSTOMER L.L.N.L Job No. 26447 Date 10-2-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 16/1

Operator GRETERMAN Engineer Full Scale 100 G

RUN # 11

TRANSMISSIBILITY



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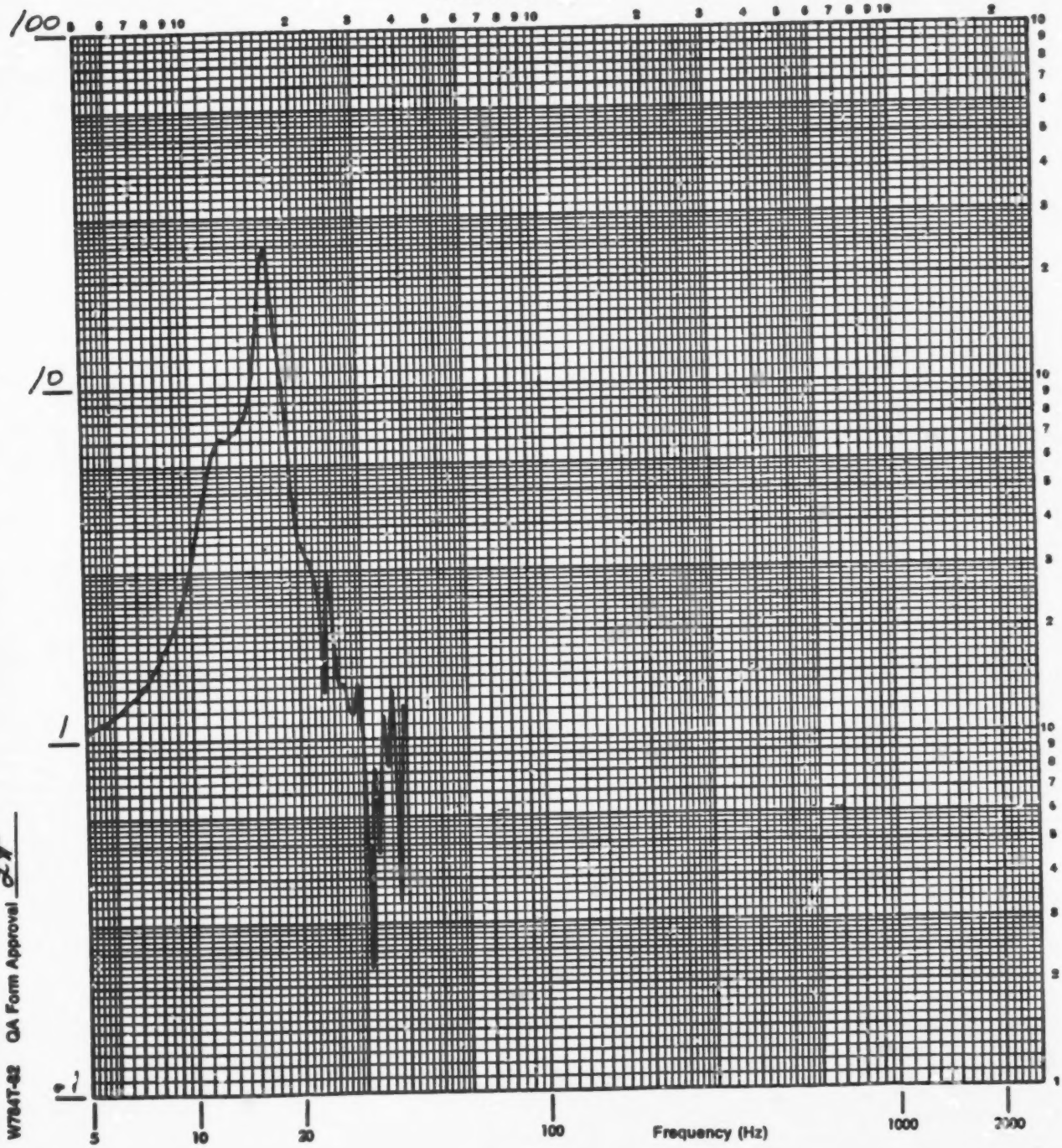
CUSTOMER L.L.N.L Job No. 26447 Date 10-2-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 17/1

Operator GREIERMAN Engineer [signature] Full Scale 100 Q

RUN # 11

TRANSMISSIBILITY



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CUSTOMER L.L.N.L Job No. 26447 Date 10-2-85

Specimen MOTOR CONTROL CENTER Test Axis X Accel. No. 18/1

Operator GREIFERMAN Engineer [signature] Full Scale 100 G

RUN# 11

TRANSMISSIBILITY

100

10

1

.1

5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2

10 9 8 7 6 5 4 3 2 1

5 10 20 100 1000 2000

Frequency (Hz)

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CUSTOMER L.L.N.L Job No. 26447 Date 10-2-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 19/1

Operator GREENMAN Engineer [signature] Full Scale 100 G

RUN# 11

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

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RUN 18

Four bolts per column with no top brace, S-S direction

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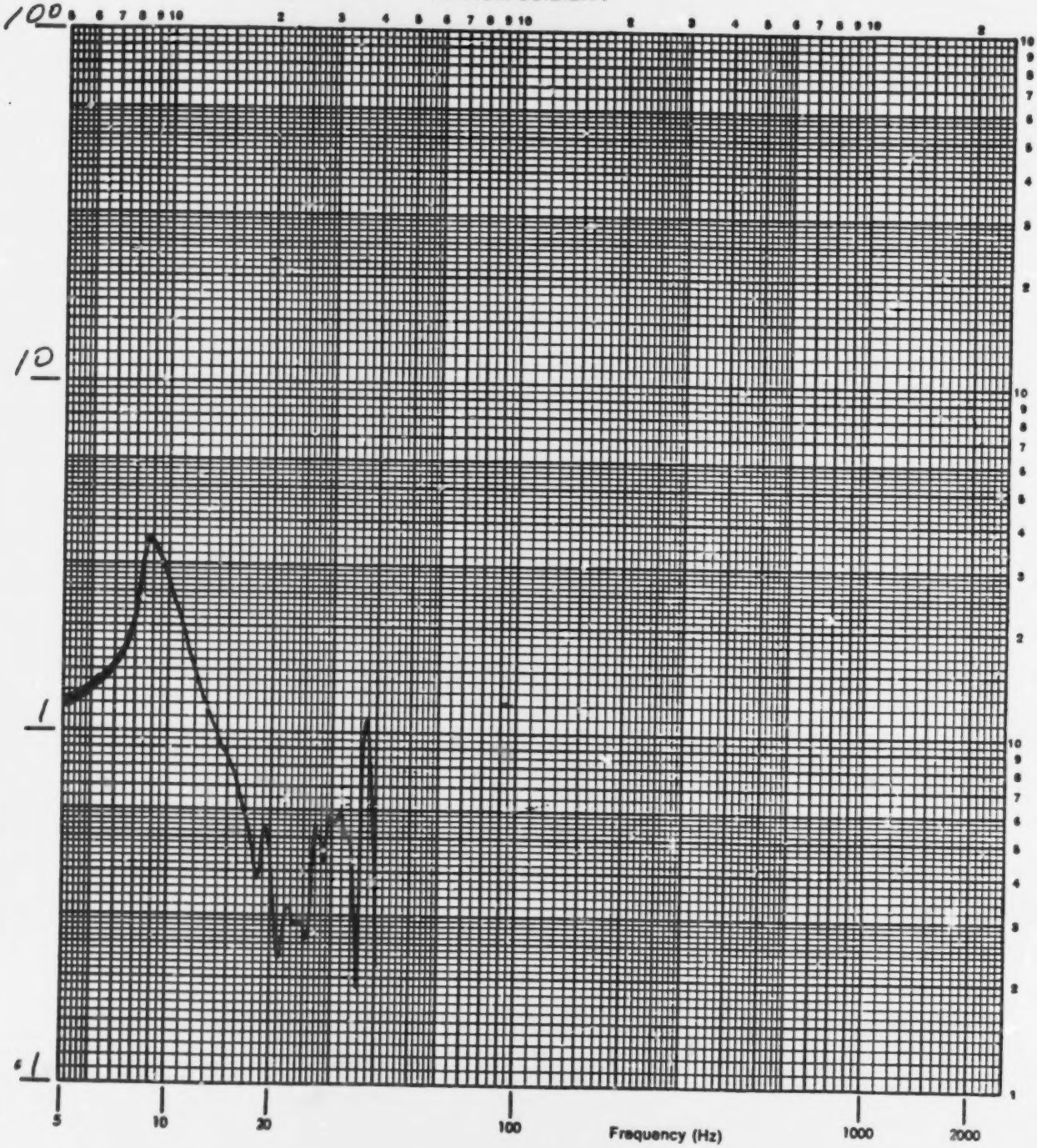
CUSTOMER L.L.N.L Job No. 26447 Date 10-3-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 3/1

Operator GREIERMAN Engineer [illegible] Full Scale 100 Q

RUN 1B

TRANSMISSIBILITY



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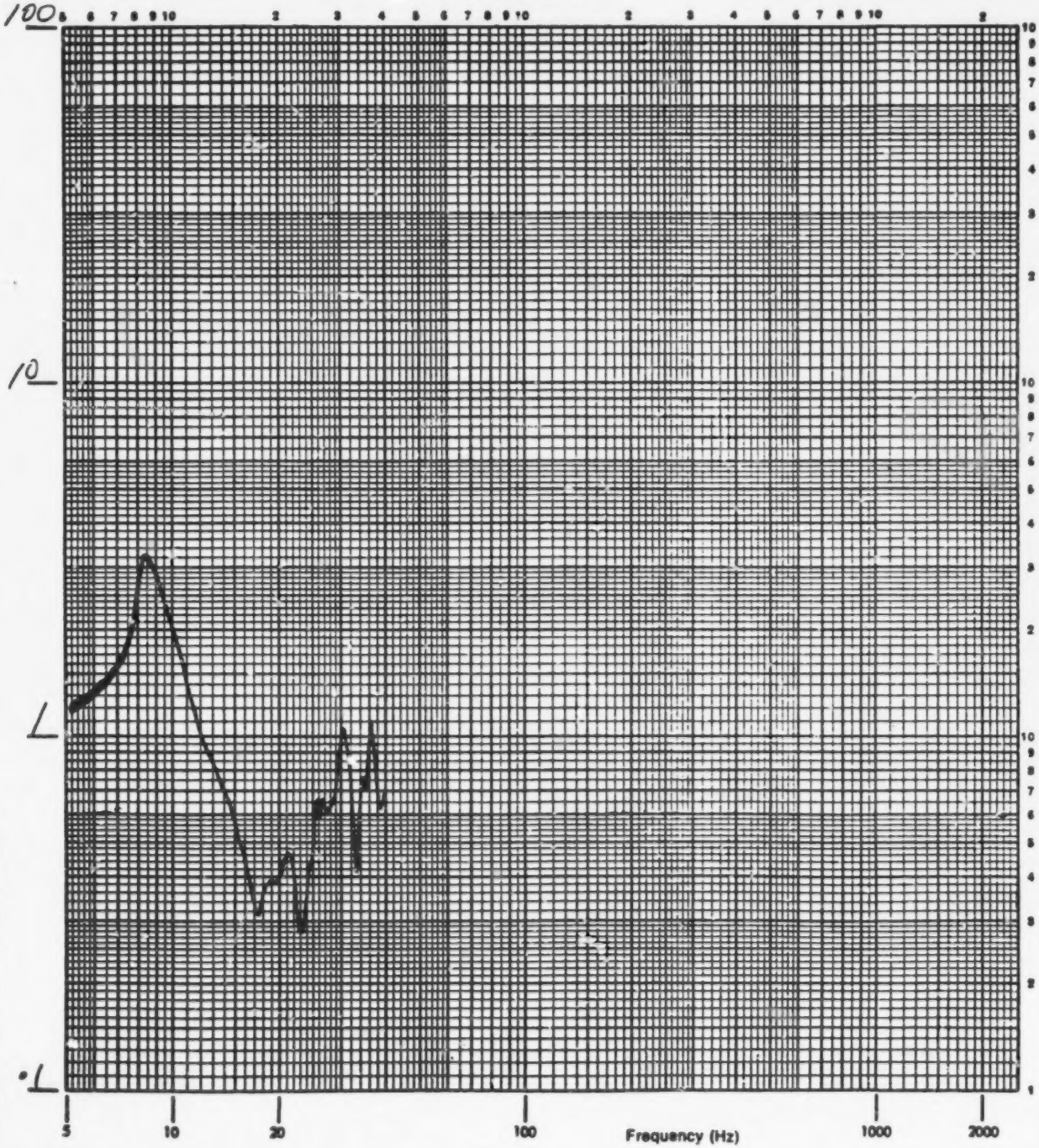
CUSTOMER L.L.N.L Job No. 26447 Date 10-3-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 4/1

Operator GREIERMAN Engineer Rizy Full Scale 100 G

RUN 18

TRANSMISSIBILITY



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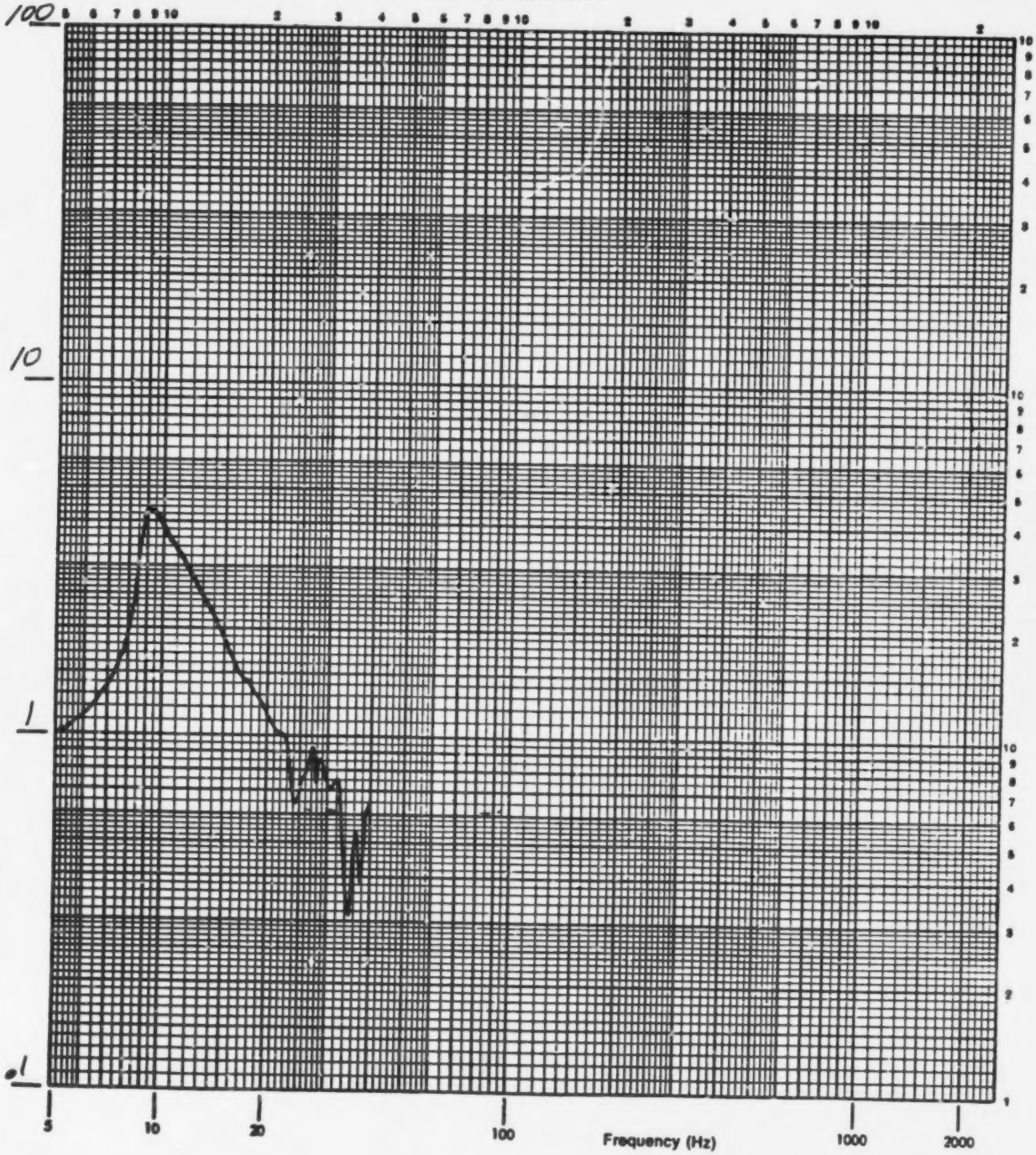
CUSTOMER L.L.N.L Job No. 26447 Date 10-3-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 5/1

Operator GREIERMAN Engineer Ring Full Scale 100 G

RUN 18

TRANSMISSIBILITY



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CUSTOMER L.L.N.L Job No. 26447 Date 10-3-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 7/1

Operator GREIERMAN Engineer KUHN Full Scale 100 Q

RUN 18

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

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CUSTOMER L.L.N.L Job No. 26447 Date 10-3-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 8/1

Operator GREIERMAN Engineer RMM Full Scale 100 G

RUN 18

TRANSMISSIBILITY

100

10

1

.1

5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2

10 9 8 7 6 5 4 3 2 10 9 8 7 6 5 4 3 2 10 9 8 7 6 5 4 3 2 1

5 10 20 100 Frequency (Hz) 1000 2000

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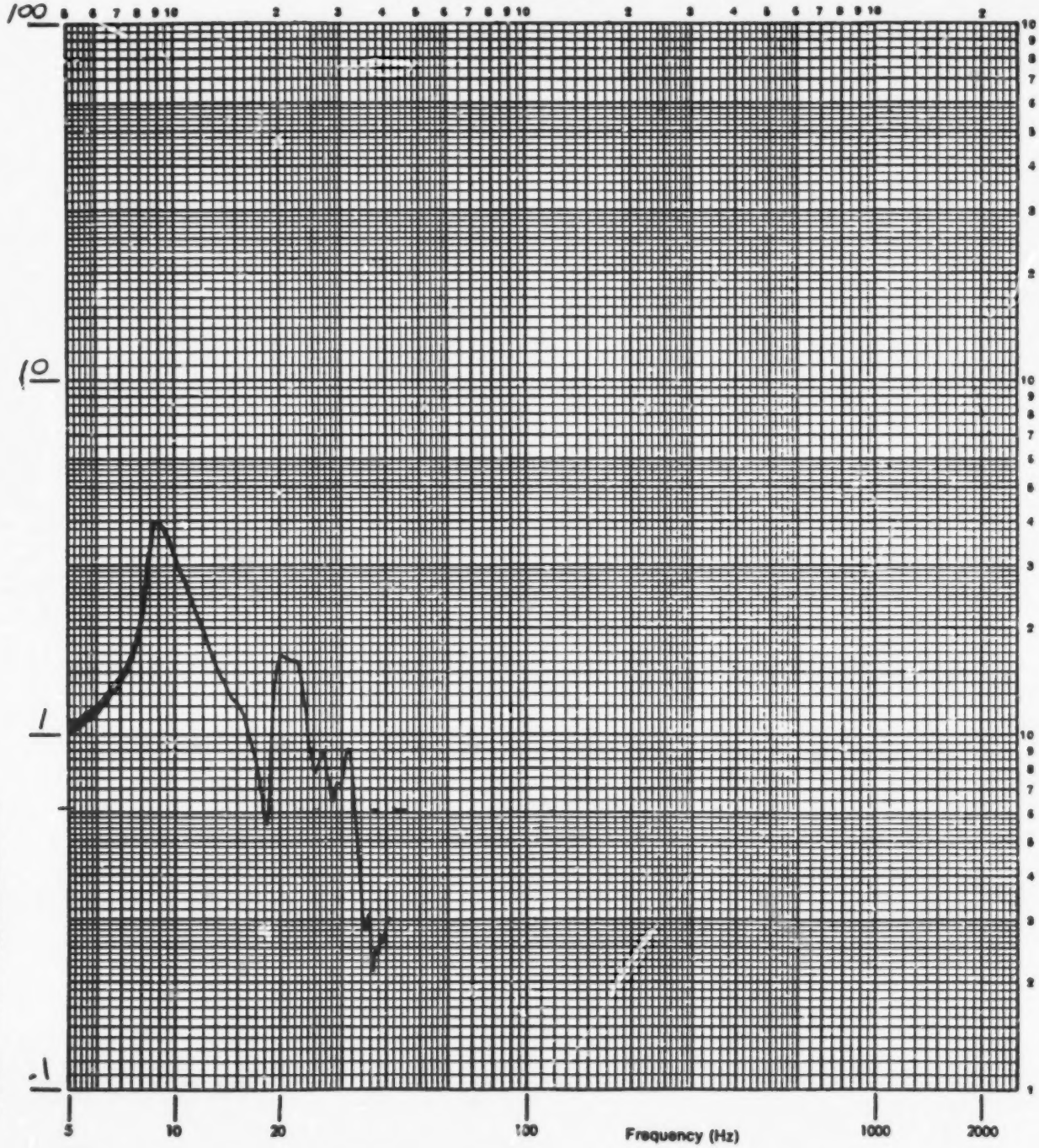
CUSTOMER L.L.N.L. Job No. 26447 Date 10-3-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 9/1

Operator GREIERMAN Engineer RMM Full Scale 100 Q

RUN 18

TRANSMISSIBILITY



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CUSTOMER L.L.N.L Job No. 26447 Date 10-3-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 10/1

Operator GREIFMAN Engineer RMM Full Scale 100 Q

RUN 18

TRANSMISSIBILITY

100

10

1

.1

5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2

10 9 8 7 6 5 4 3 2 10 9 8 7 6 5 4 3 2 10 9 8 7 6 5 4 3 2 1

5 10 20 100 Frequency (Hz) 1000 2000

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER: L.L.N.L Job No. 26447 Date 10-3-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 11/1

Operator GREIERMAN Engineer [illegible] Full Scale 100 G

RUN 18

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L. Job No. 26447 Date 10-3-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 13/1

Operator GREIERMAN Engineer [illegible] Full Scale 100 G

RUN 18

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

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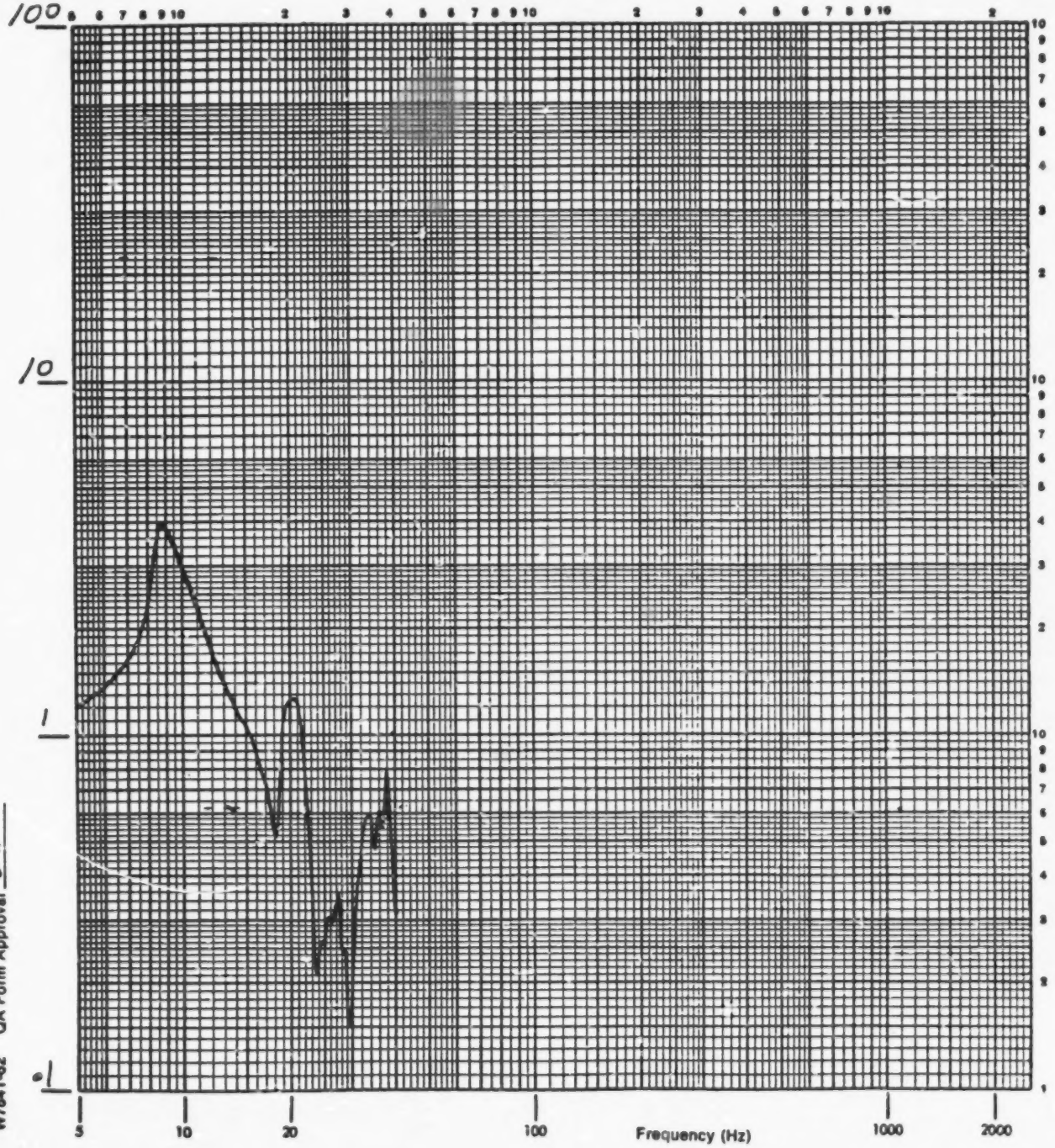
CUSTOMER L.L.N.L Job No. 26447 Date 10-3-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 14/1

Operator GREIERMAN Engineer [illegible] Full Scale 100 G

RUN 18

TRANSMISSIBILITY



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Report No. 26448

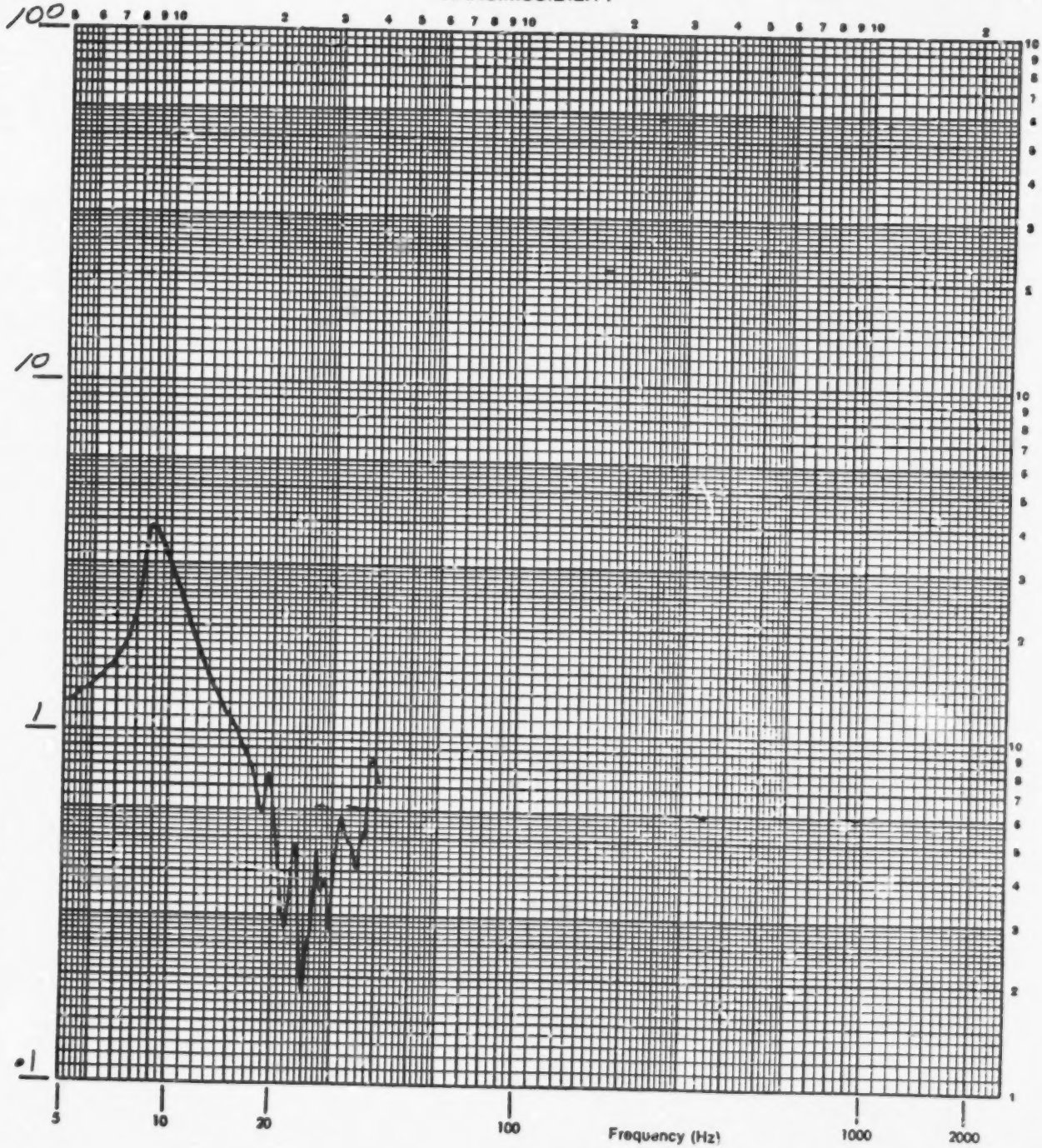
CUSTOMER L.L.N.L Job No. 26447 Date 10-3-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 15/1

Operator GREIFERMAN Engineer RMM Full Scale 100 G

RUN 14

TRANSMISSIBILITY



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CUSTOMER L.L.N.L Job No. 26447 Date 10-3-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 16/1

Operator GREIFMAN Engineer [illegible] Full Scale 100

RUN 18

TRANSMISSIBILITY

100

10

1

.1

5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2

10 9 8 7 6 5 4 3 2 10 9 8 7 6 5 4 3 2 10 9 8 7 6 5 4 3 2 1

5 10 20 100 Frequency (Hz) 1000 2000

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L. Job No 26447 Date 10-3-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 17/1

Operator GREENMAN Engineer [signature] Full Scale 100 G

RUN 18

TRANSMISSIBILITY

100

10

1

.1

5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2

10 9 8 7 6 5 4 3 2 10 9 8 7 6 5 4 3 2 10 9 8 7 6 5 4 3 2 1

5 10 20 100 Frequency (Hz) 1000 2000

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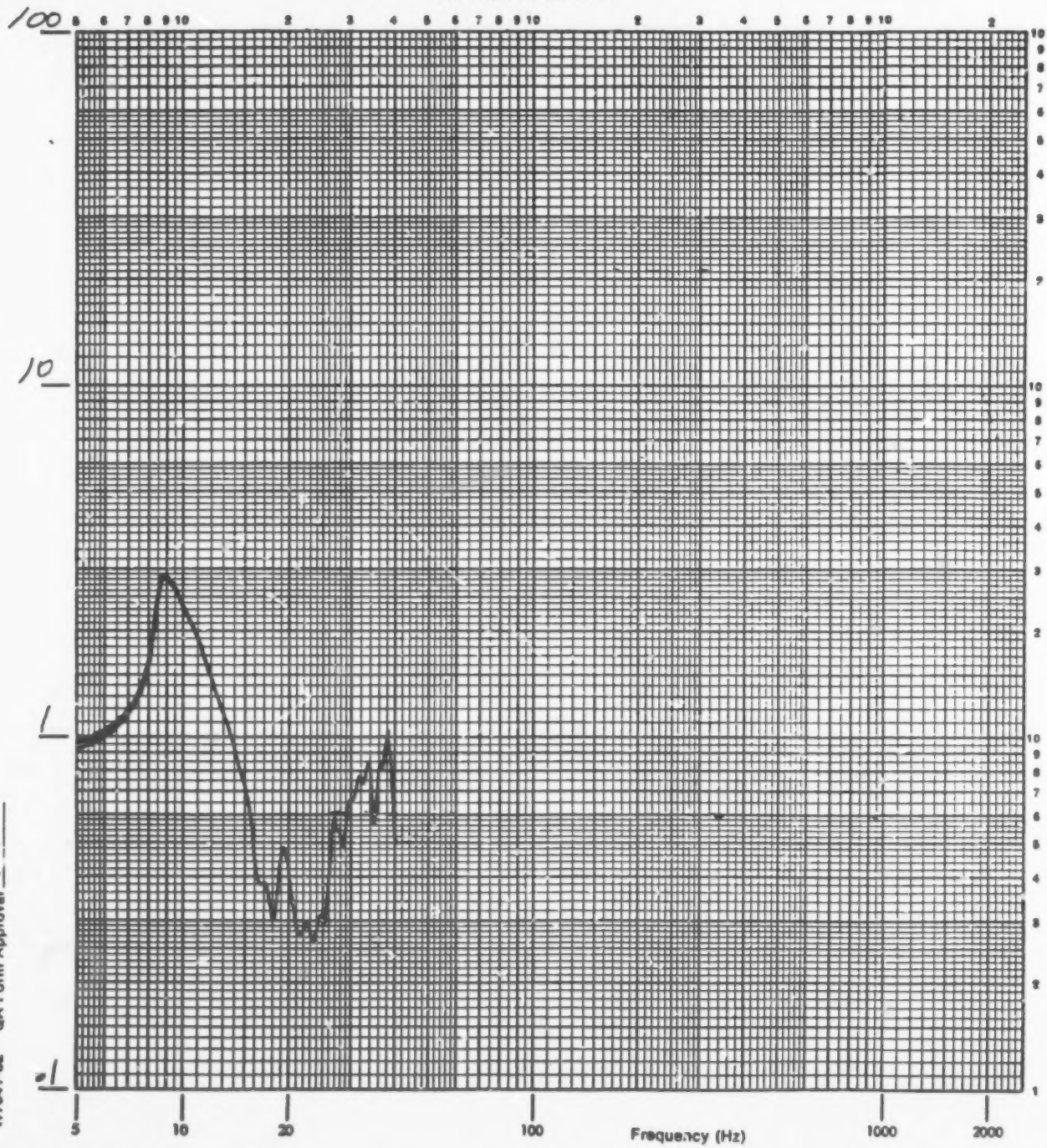
CUSTOMER L.L.N.L Job No. 26447 Date 10-3-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 18/1

Operator BREIERMAN Engineer [illegible] Full Scale 100 G

RUN 18

TRANSMISSIBILITY



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CUSTOMER L.L.N.L Job No. 26947 Date 10-3-85

Specimen MOTOR CONTROL UNIT Test Axis Z Accel. No. 19/1

Operator GREIERMAN Engineer [illegible] Full Scale 100 G

RUN 18

TRANSMISSIBILITY

100

10

1

.1

5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2

10 9 8 7 6 5 4 3 2 10 9 8 7 6 5 4 3 2 10 9 8 7 6 5 4 3 2 1

5 10 20 100 1000 2000

Frequency (Hz)

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RUN 19

Four bolts per column with no top brace, vertical direction

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CUSTOMER L.L.N.L Job No. 26447 Date 10-4-85

Specimen MOTOR CONTROL UNIT Test Axis Y Accel. No. 6/2

Operator GREIERMAN Engineer [illegible] Full Scale 100 G

RUN 19

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L Job No. 26447 Date 10-3-85

Specimen MOTOR CONTROL UNIT Test Axis Y Accel. No. 12/2

Operator GREIFFMAN Engineer [illegible] Full Scale 100 Q

RUN 19

TRANSMISSIBILITY

100

10

1

.1

5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2

10 9 8 7 6 5 4 3 2 1

5 10 20 100 Frequency (Hz) 1000 2000

W784T-82 QA Form Approval [illegible]

RUN 26

Four bolts per column with no top brace, F-B direction

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

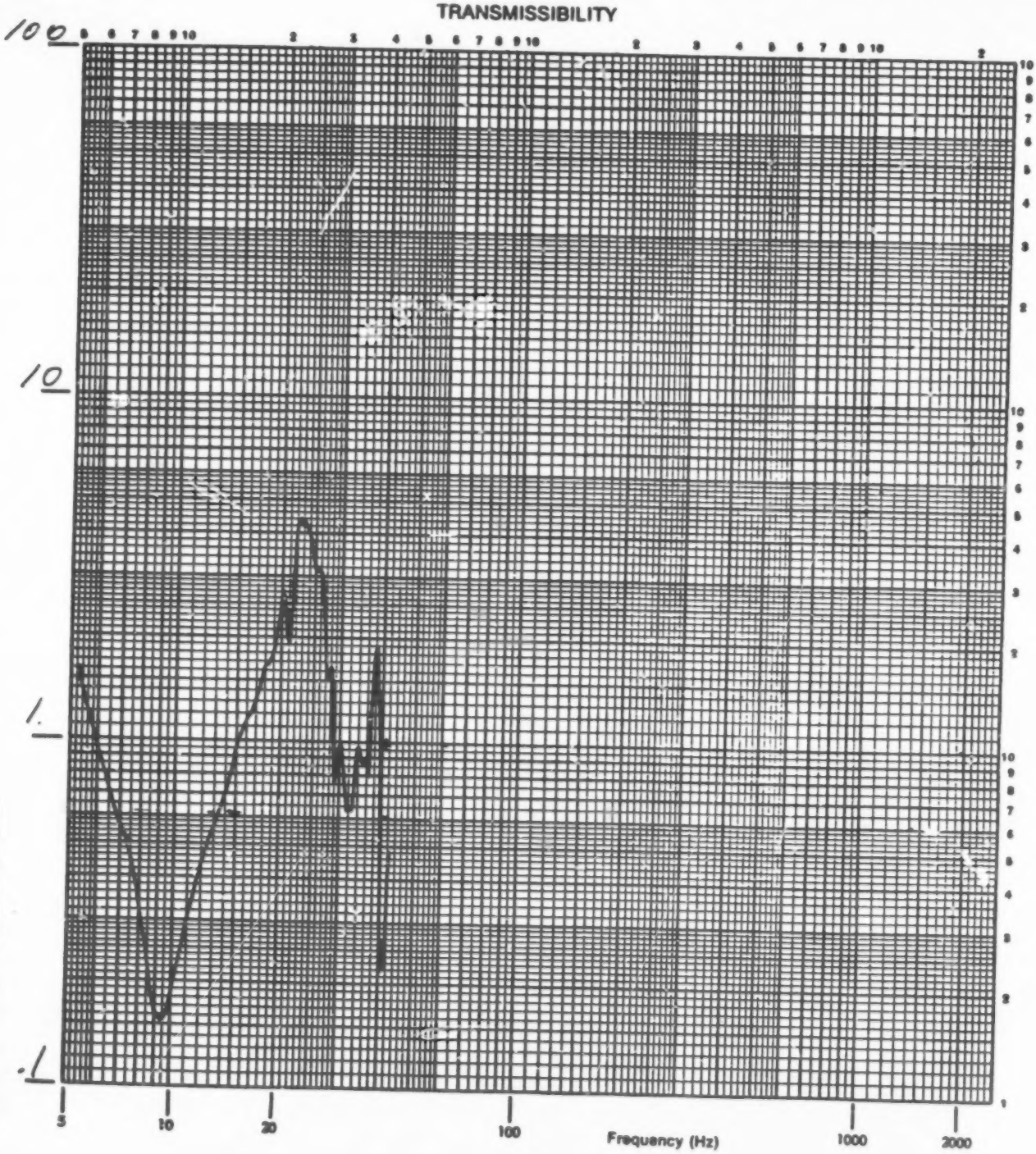
CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 3/1

Operator GREIERMAN Engineer [illegible] Full Scale 100 Q

RUN #26

TRANSMISSIBILITY



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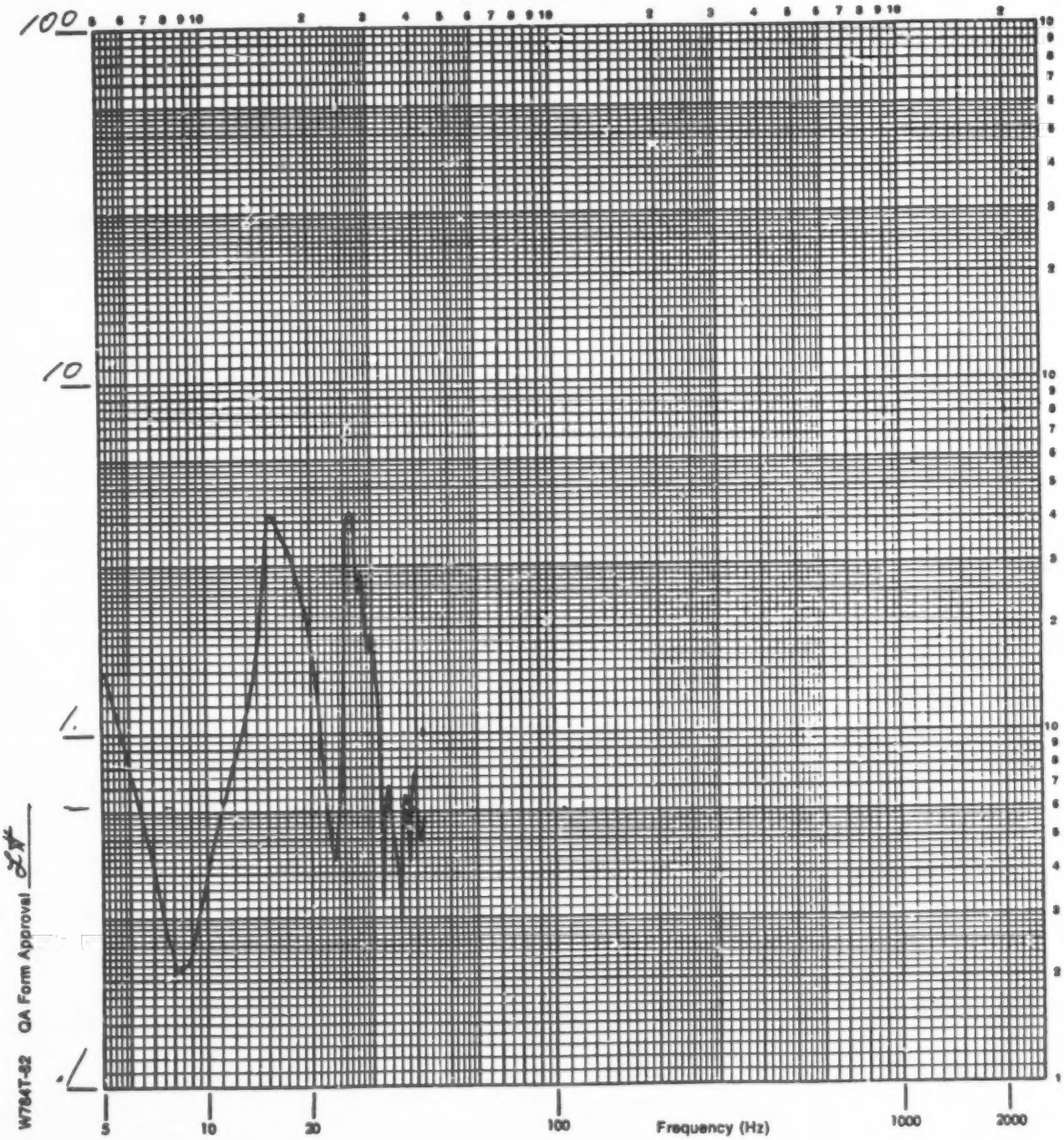
CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 4/1

Operator GREIERMAN Engineer [illegible] Full Scale 100 G

RUN #26

TRANSMISSIBILITY



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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

Report No. 26448

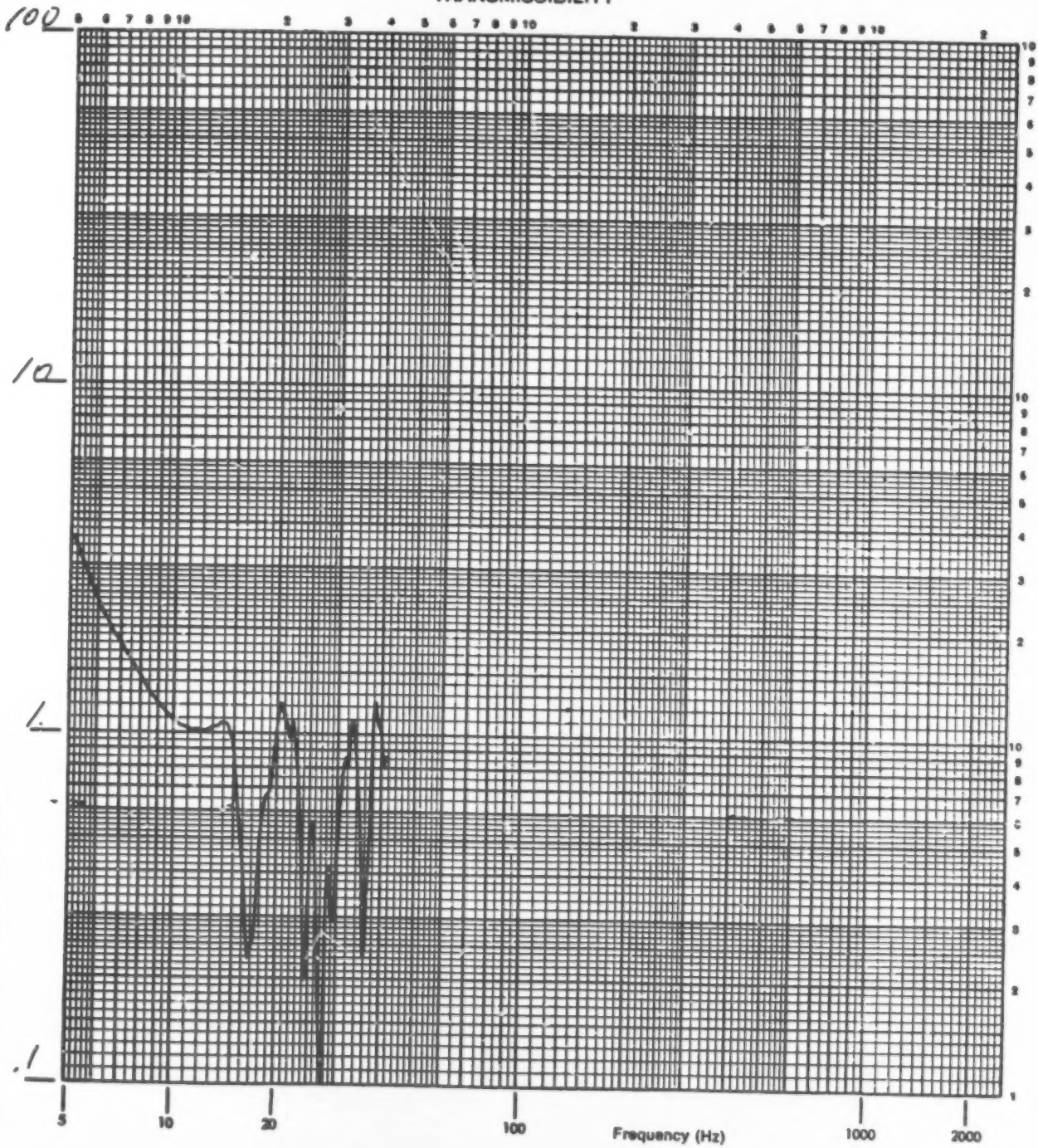
CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 5/1

Operator GREENMAN Engineer [signature] Full Scale 100 G

RUN #26

TRANSMISSIBILITY



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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 7/1

Operator GRETERMAN Engineer [signature] Full Scale 100 G

Run #26

TRANSMISSIBILITY

100

10

1.

.1

5 10 20 100 Frequency (Hz) 1000 2000

W784T-82 QA Form Approval [signature]

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

Report No. 26448

Page No. A-57

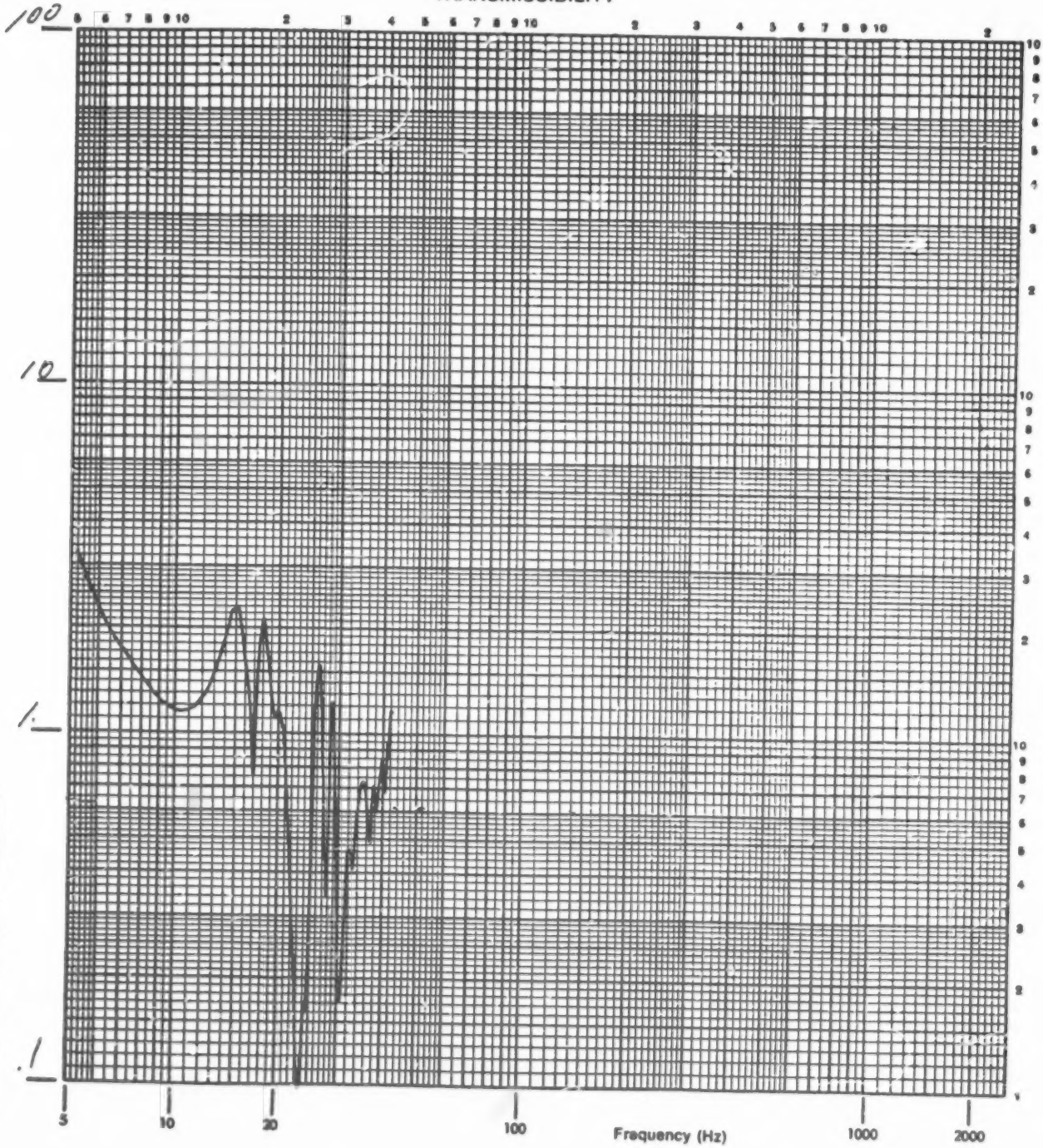
CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 8/1

Operator GREENMAN Engineer _____ Full Scale 100 G

RUN #26

TRANSMISSIBILITY



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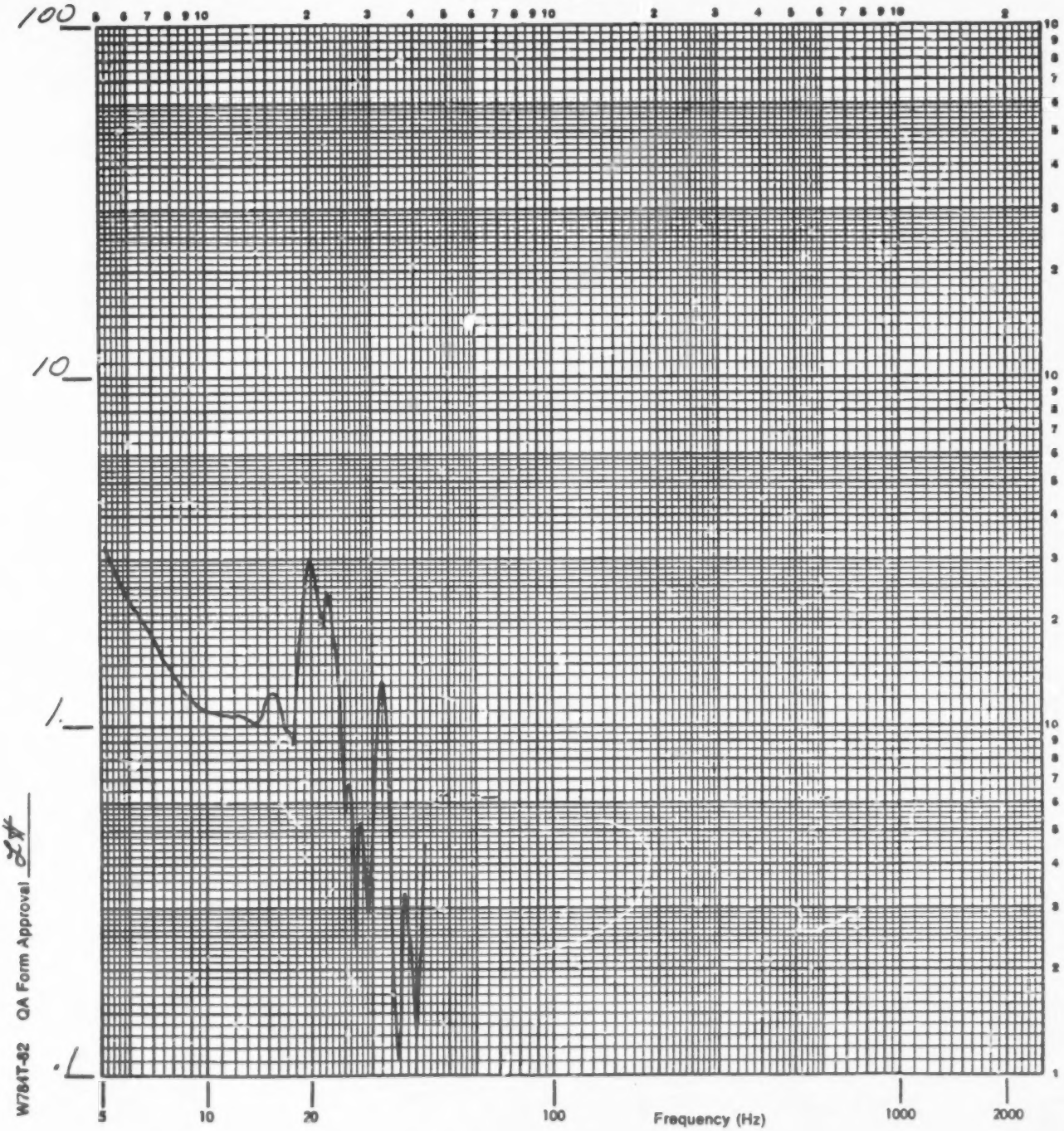
CUSTOMER L. L. N. L. Job No. 26447 Date 10-25-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 9/1

Operator BREIERMAN Engineer [illegible] Full Scale 100 G

RUN #26

TRANSMISSIBILITY



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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 10/1

Operator GREIERMAN Engineer [illegible] Full Scale 100 G

Run # 26

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 1000 2000

Frequency (Hz)

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

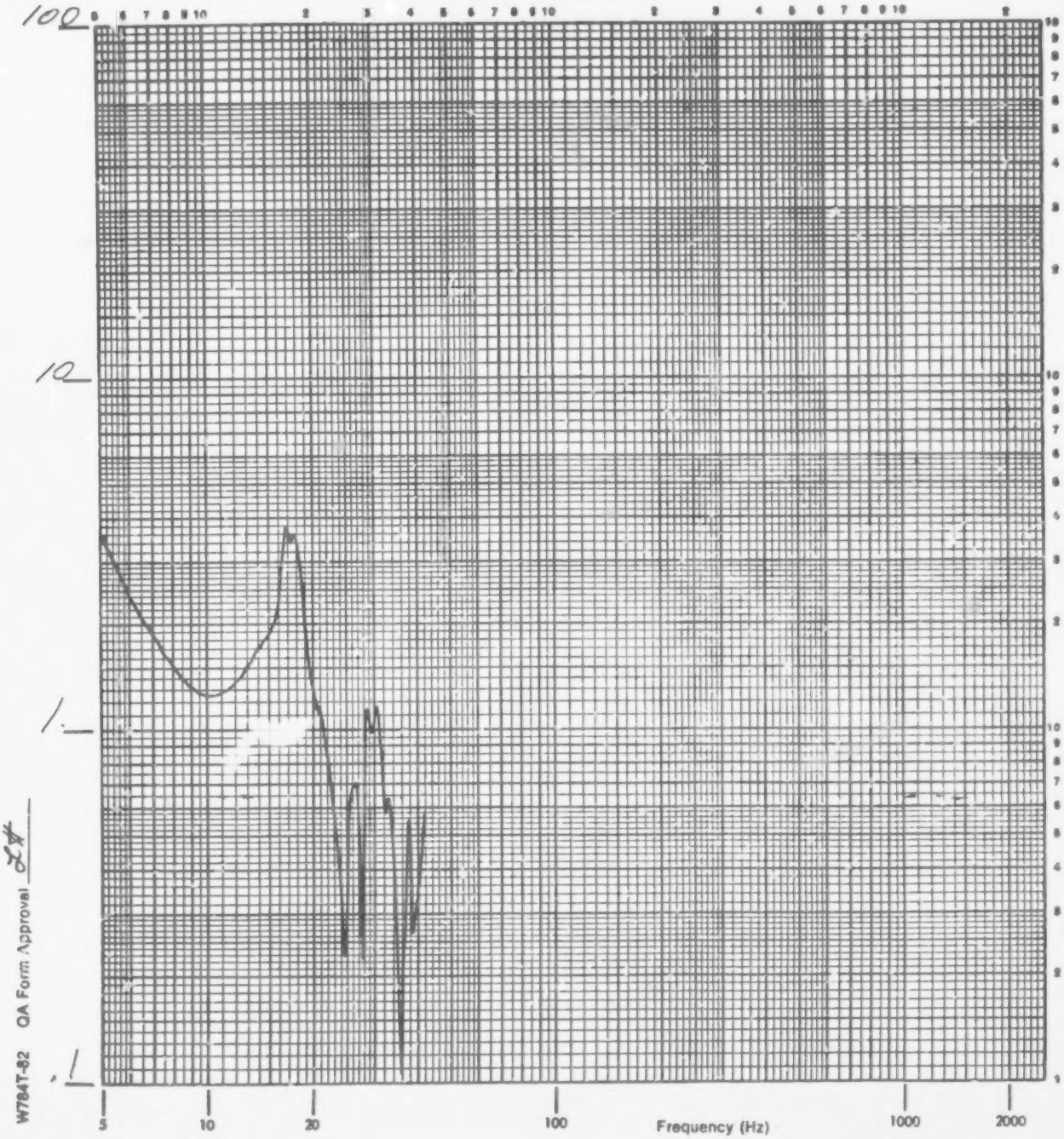
CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 11/1

Operator GREIERMAN Engineer Burn Full Scale 100 G

RUN #26

TRANSMISSIBILITY



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Report No. 26448

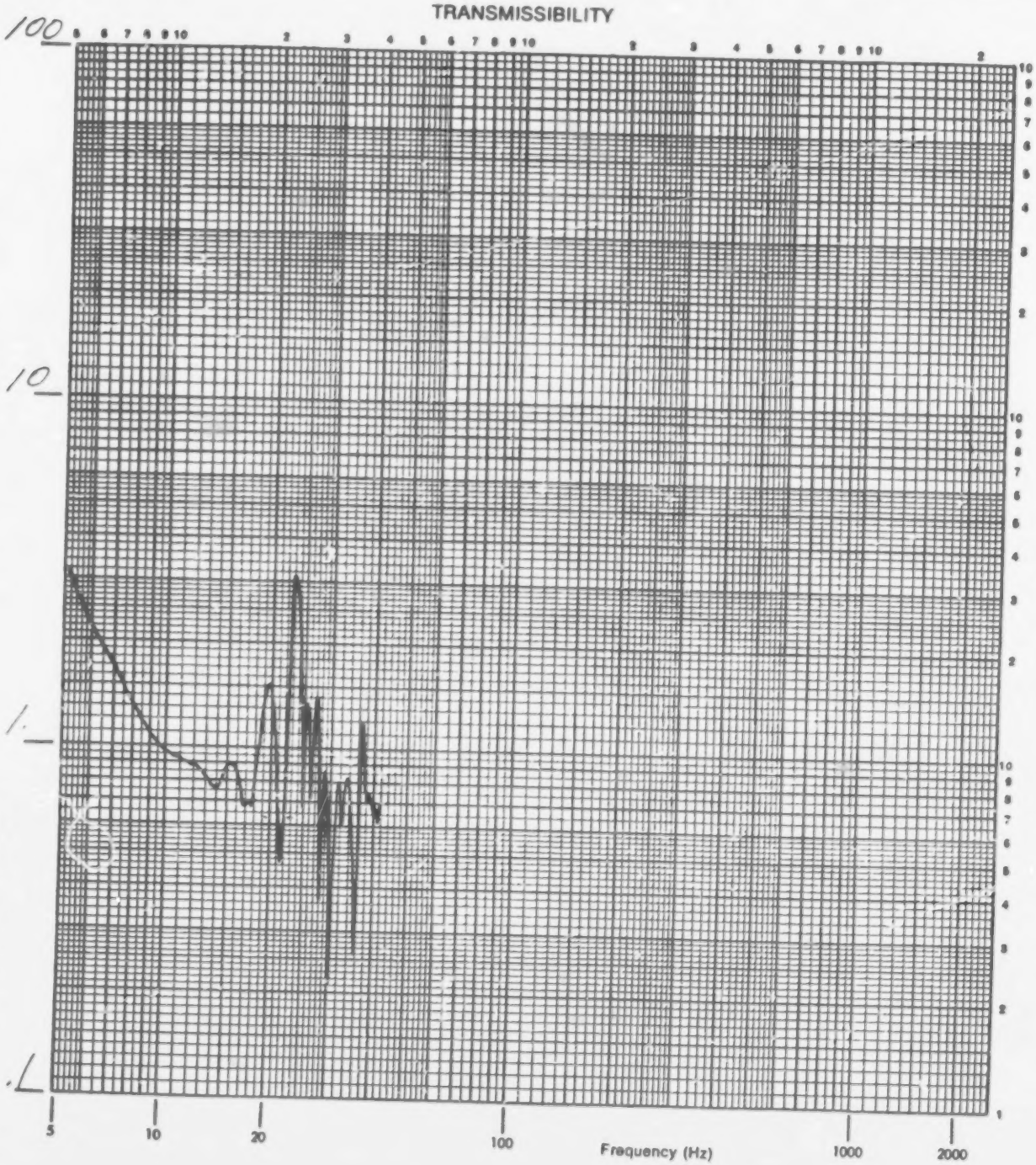
Page No. A-61

CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 13/1

Operator GRETERMAN Engineer [illegible] Full Scale 100 Q

RUN#26



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CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 14/1

Operator GREIERMAN Engineer [illegible] Full Scale 100 Q

RUN # 26

TRANSMISSIBILITY

100

10

1.

.1

5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2

10 9 8 7 6 5 4 3 2 1

5 10 20 100 Frequency (Hz) 1000 2000

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

Report No. 26448

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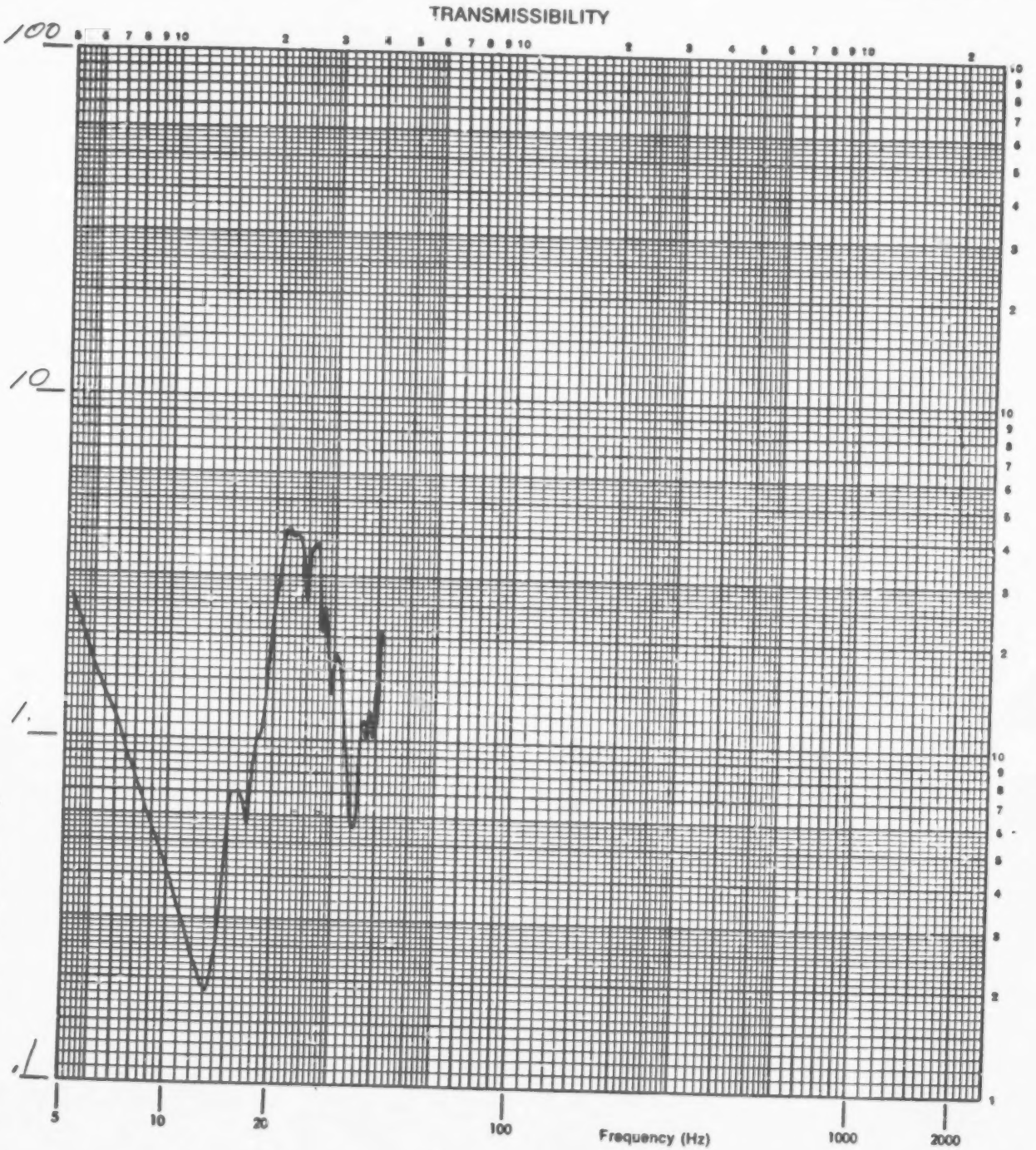
CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 15/1

Operator GREIERMAN Engineer [illegible] Full Scale 100 Q

RUN# 26



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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 16/1

Operator GREENMAN Engineer [illegible] Full Scale 100 0

RUN #26

TRANSMISSIBILITY

100

12

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

Report No. 26448

Page No. A-65

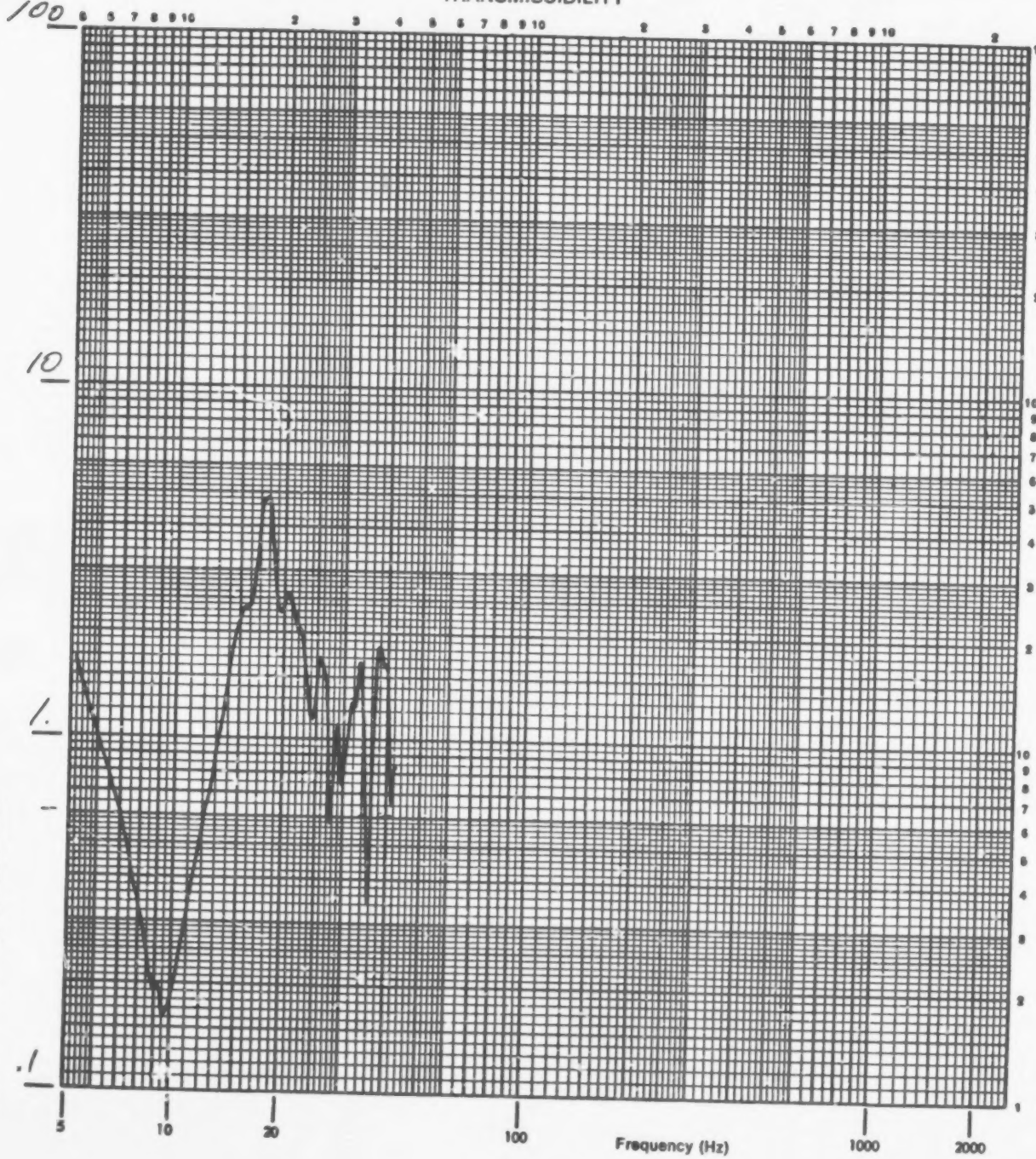
CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 17/1

Operator _____ Engineer _____ Full Scale 100 G

Run #26

TRANSMISSIBILITY



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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L. L. N. L. Job No. 26447 Date 10-25-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 18/1

Operator _____ Engineer _____ Full Scale 100 Q

Run #26

TRANSMISSIBILITY

100 10 1 .1

5 10 20 100 1000 2000

Frequency (Hz)

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 19/1

Operator _____ Engineer _____ Full Scale 100 G

Run #26

TRANSMISSIBILITY

100

10

1.

.1

5 10 20 100 Frequency (Hz) 1000 2000

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RUN 33

Two bolts per column with no top brace, S-S direction

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CUSTOMER LLNL Job No. 26447 Date 12-3-85

Specimen MOTOR CONTROL UNIT Test Axis S/S Accel. No. 3/1

Operator BRETERMAN Engineer [signature] Full Scale 100 Q

RUN 33

TRANSMISSIBILITY

100

10

1

.1

5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2

10 9 8 7 6 5 4 3 2 1

5 10 20 100 Frequency (Hz) 1000 2000

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CUSTOMER L.L.N.L. Job No. 26447 Date 12-3-85

Specimen MOTOR CONTROL UNIT Test Axis S/S Accel. No. 4/1

Operator GRETERMAN Engineer _____ Full Scale 100 Q

RUN 33

TRANSMISSIBILITY

100

10

1

.1

Frequency (Hz)

5 10 20 100 1000 2000

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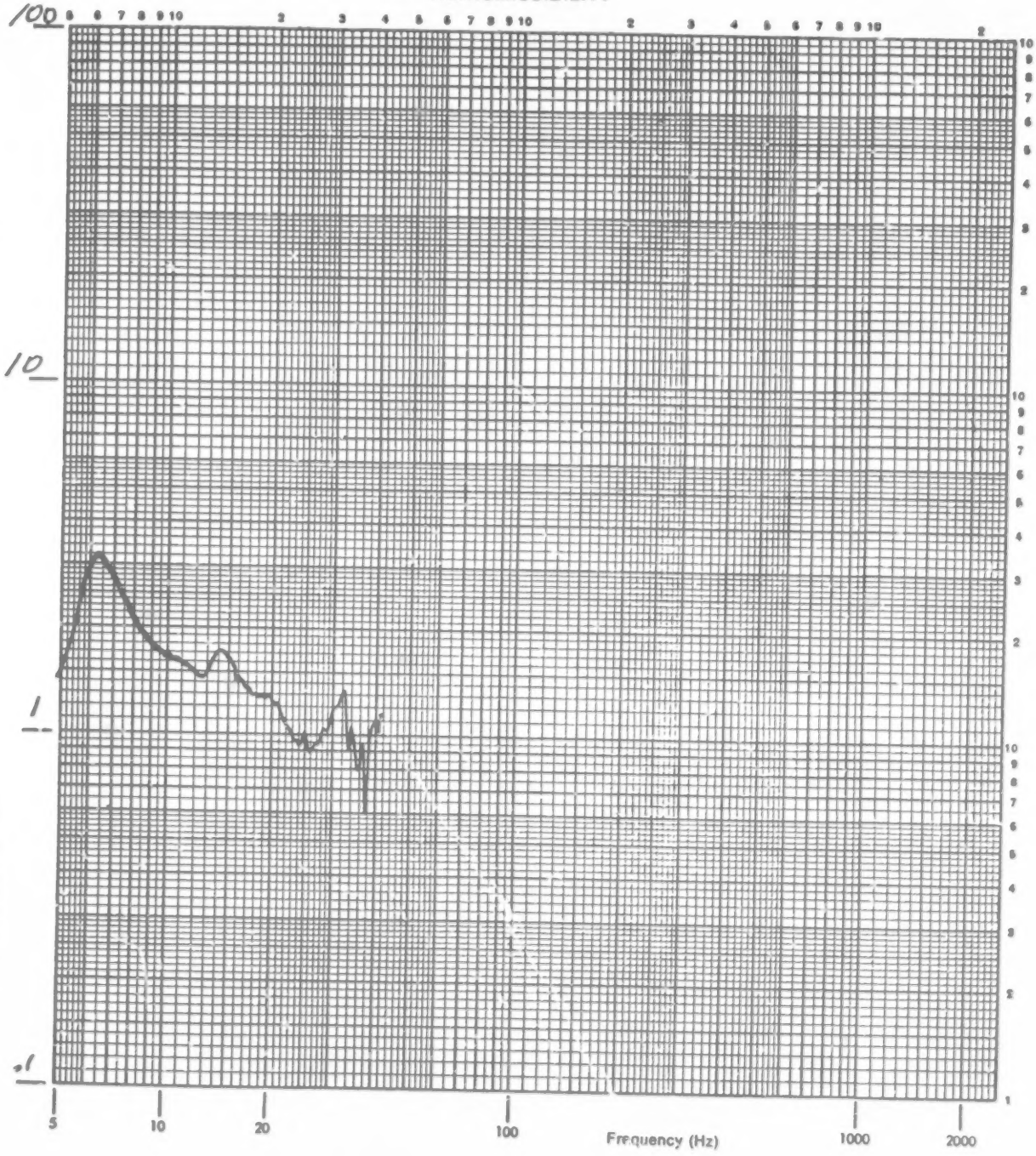
CUSTOMER L.L.N.L. Job No. 26447 Date 12-3-85

Specimen MOTOR CONTROL UNIT Test Axis S/S Accel. No. 5/1

Operator GREIERMAN Engineer _____ Full Scale 100 G

RUN 33

TRANSMISSIBILITY



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CUSTOMER L.L.N.L Job No 26447 Date 12-3-85

Specimen MOTOR CONTROL UNIT Test Axis S/S Accel No 7/1

Operator GREENERMAN Engineer [illegible] Full Scale 100 G

RUN 33

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 1000 2000

Frequency (Hz)

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER LLNL Job No 26447 Date 12-3-85

Specimen MOTOR CONTROL UNIT Test Axis S/S Accel No 8/1

Operator GREIERMAN Engineer [illegible] Full Scale 100 Q

RUN 33

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

IW784T-82 QA Form Approval [illegible]

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

Job No 26447 Date 12-3-85

CUSTOMER LLNL

Specimen MOTOR CONTROL UNIT Test Axis S/S Accel No 9/1

Operator GRETERMAN Engineer [illegible] Full Scale 100 Q

RUN 33

TRANSMISSIBILITY

100

10

1

.1

Frequency (Hz)

5 10 20 100 1000 2000

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16

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER LLNL Job No 26447 Date 12-3-85

Specimen MOTOR CONTROL UNIT Test Axis S/S Accel No 10/1

Operator BRETERMAN Engineer [illegible] Full Scale 100 G

RUN 33

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 1000 2000

Frequency (Hz)

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L. Job No 26447 Date 12-3-85

Specimen MOTOR CONTROL UNIT Test Axis S/S Accel No 11/1

Operator GREIERMAN Engineer [signature] Full Scale 100 G

RUN 33

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

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LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

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Report No. 26448

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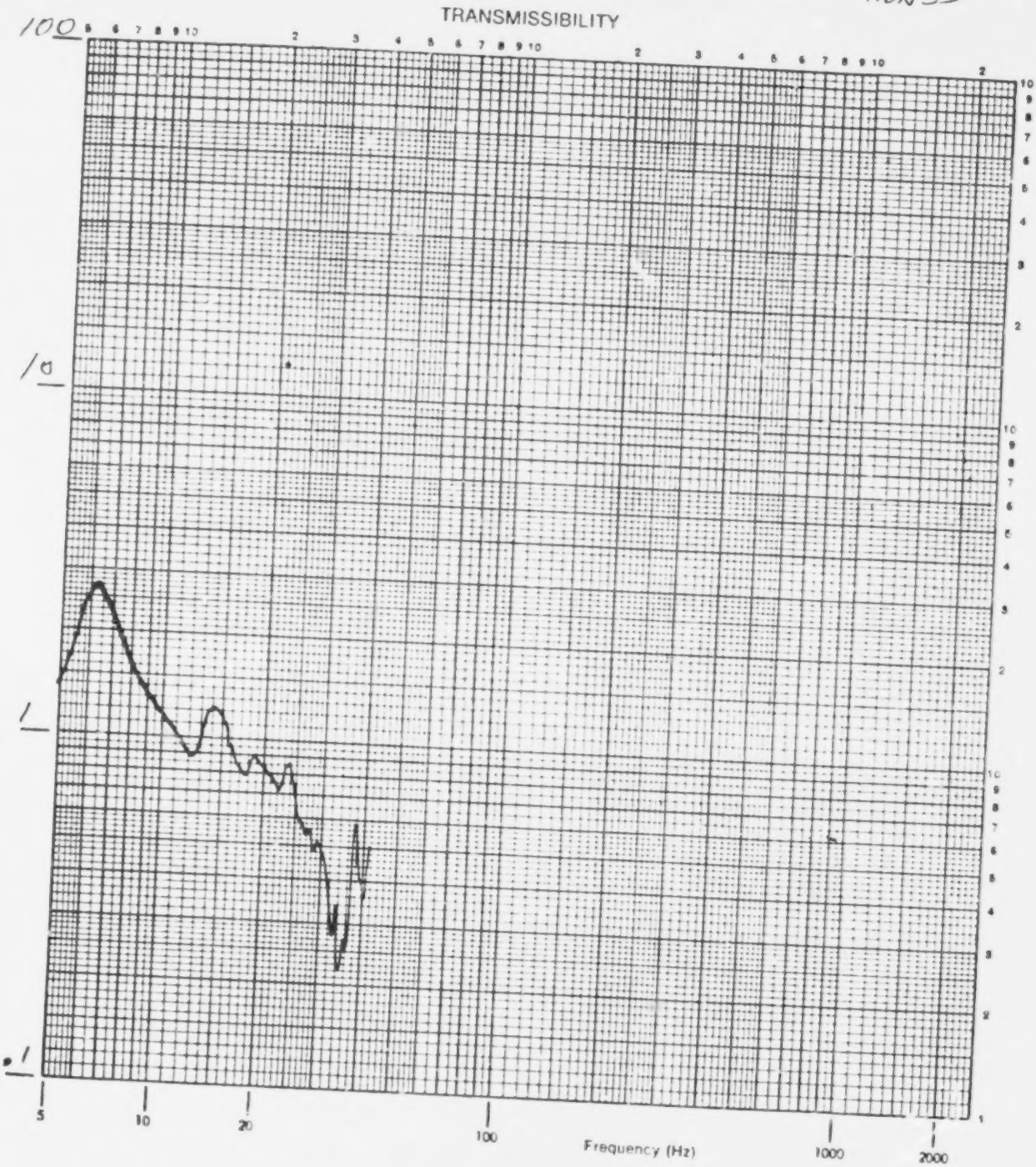
CUSTOMER L.L.N.L. Job No 26447 Date 12-3-85

Specimen MOTOR CONTROL UNIT Test Axis S/S Accel No. 13/1

Operator BRETERMAN Engineer [signature] Full Scale 100 Q

RUN 33



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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L. Job No. 26447 Date 12-3-85

Specimen MOTOR CONTROL UNIT Test Axis S/S Accel. No. 14/1

Operator C. PETERMAN Engineer [signature] Full Scale 100 g

RUN 33

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 1000 2000

Frequency (Hz)

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100

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

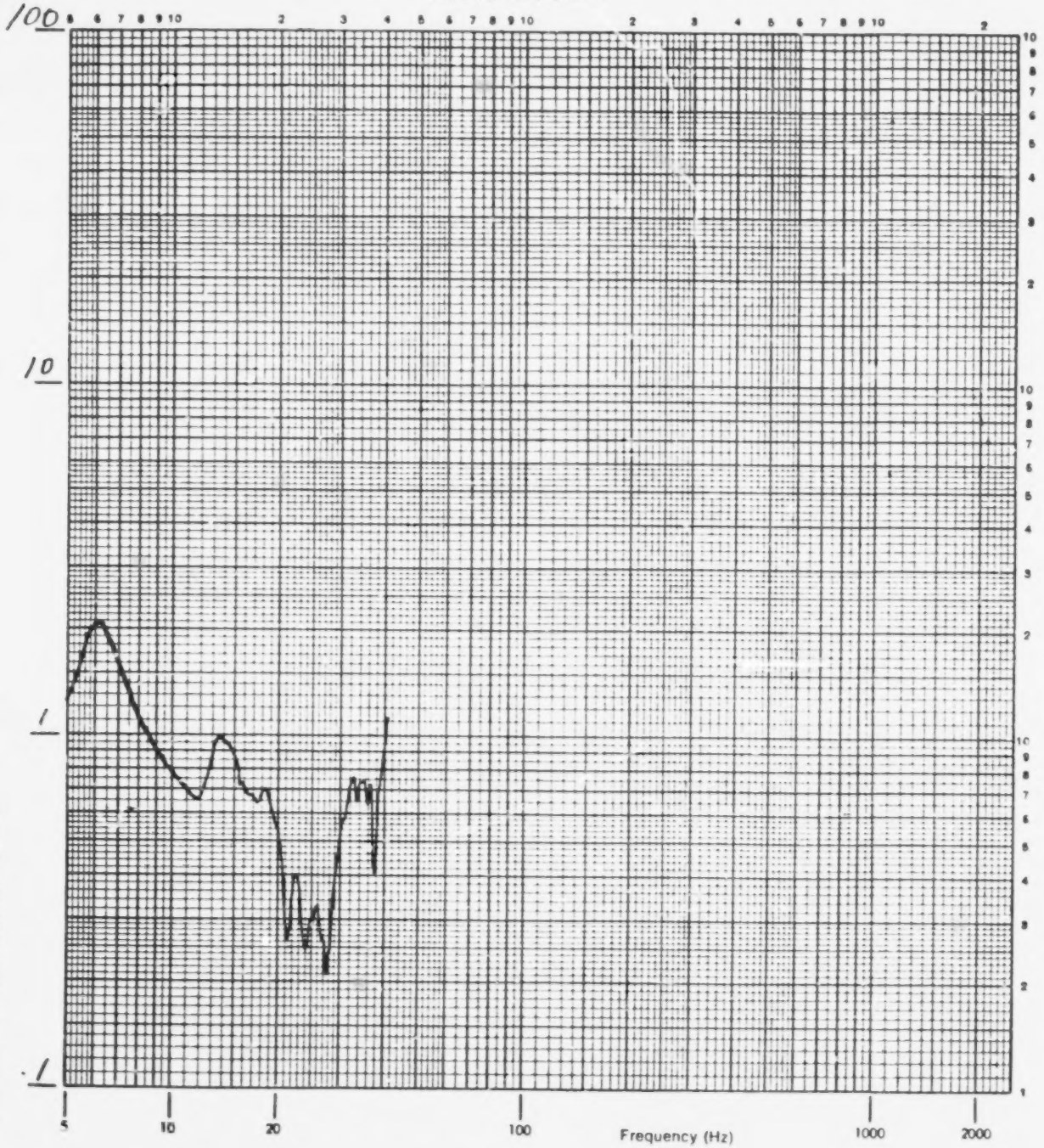
CUSTOMER L.L.N.L. Job No 26447 Date 12-3-85

Specimen MOTOR CONTROL UNIT Test Axis S/S Accel. No 15/1

Operator GREETERMAN Engineer [illegible] Full Scale 100 G

RUN 33

TRANSMISSIBILITY



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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER LLNL Job No 26447 Date 12-3-85

Specimen MOTOR CONTROL UNIT Test Axis S/S Accel No 16/1

Operator BRETERMAN Engineer [illegible] Full Scale 100 G

RUN 33

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER LLNL Job No 26447 Date 12-3-85

Specimen MOTOR CONTROL UNIT Test Axis S/S Accel No 17/1

Operator GREIERMAN Engineer [illegible] Full Scale 100 G

RUN 33

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 1000 2000

Frequency (Hz)

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

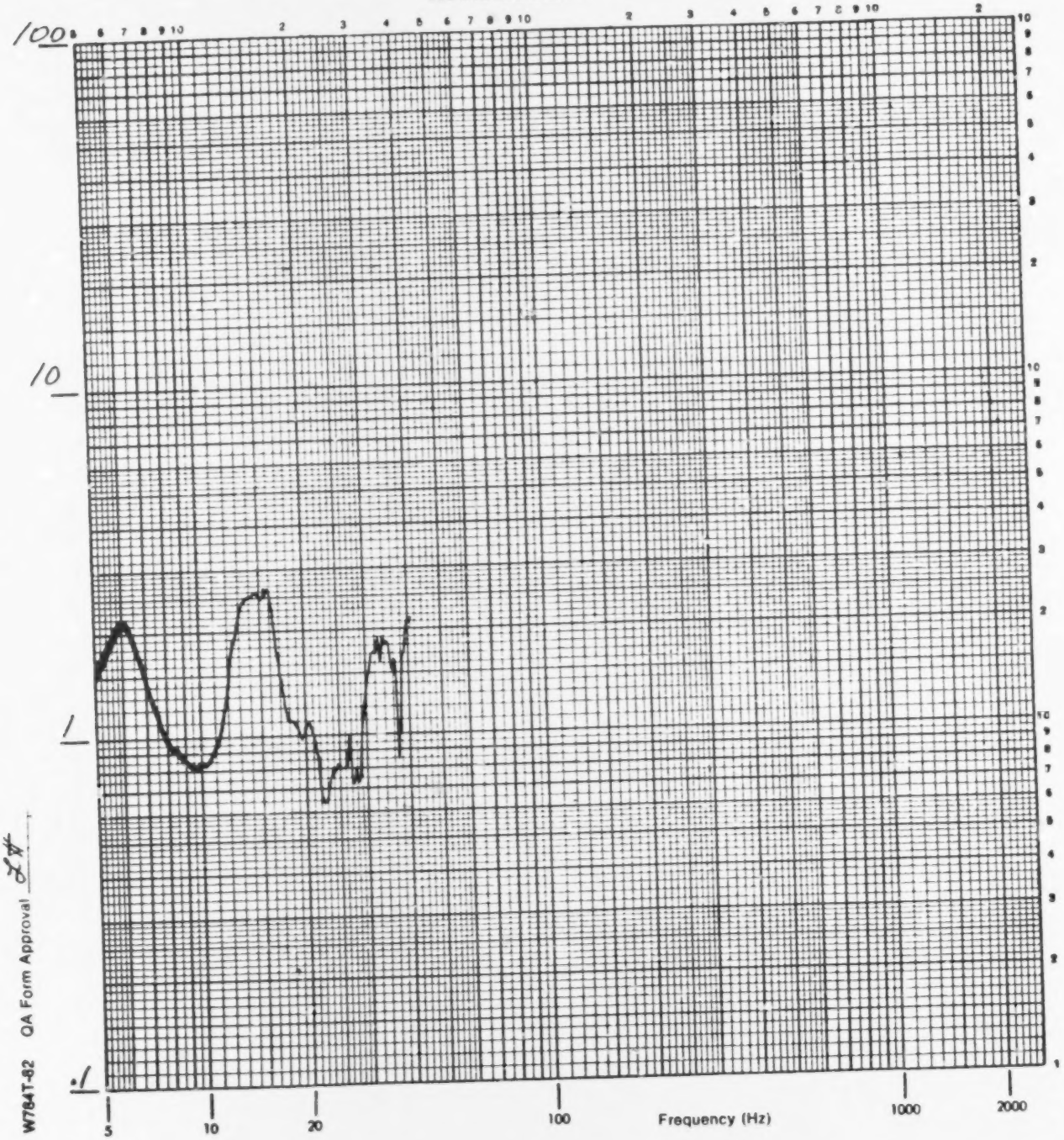
CUSTOMER L.L.N.L. Job No. 26447 Date 12-3-85

Specimen MOTOR CONTROL UNIT Test Axis S/S Accel No. 18/1

Operator BREIERMAN Engineer [signature] Full Scale 100 Q

RUN 33

TRANSMISSIBILITY



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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

Report No. 26448

CUSTOMER LLNL Job No 26447 Date 12-3-85

Specimen MOTOR CONTROL UNIT Test Axis S/S Accel. No. 19/1

Operator BRETERMAN Engineer [illegible] Full Scale 100 G

RUN 33

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 1000 2000

Frequency (Hz)

W784T-82 QA Form Approval [illegible]

RUN 34

Two bolts per column with no top brace, vertical direction

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LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

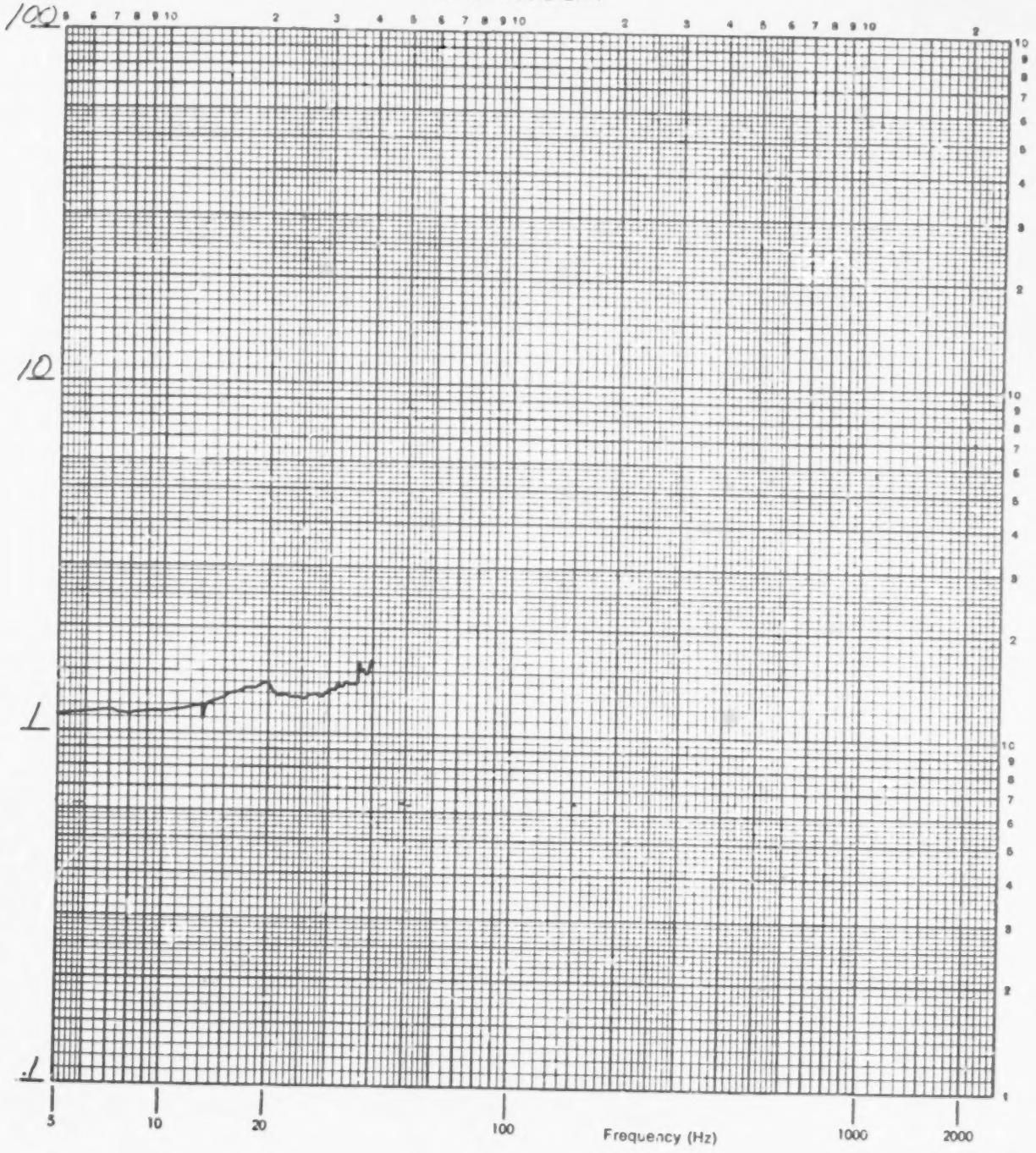
CUSTOMER L.L.N.L Job No 26447 Date 12-4-85

Specimen MOTOR CONTROL CENTER Test Axis Y Accel No 6/2

Operator BRETERMAN Engineer [signature] Full Scale 100 Q

Run 34

TRANSMISSIBILITY



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Report No. 26448

WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

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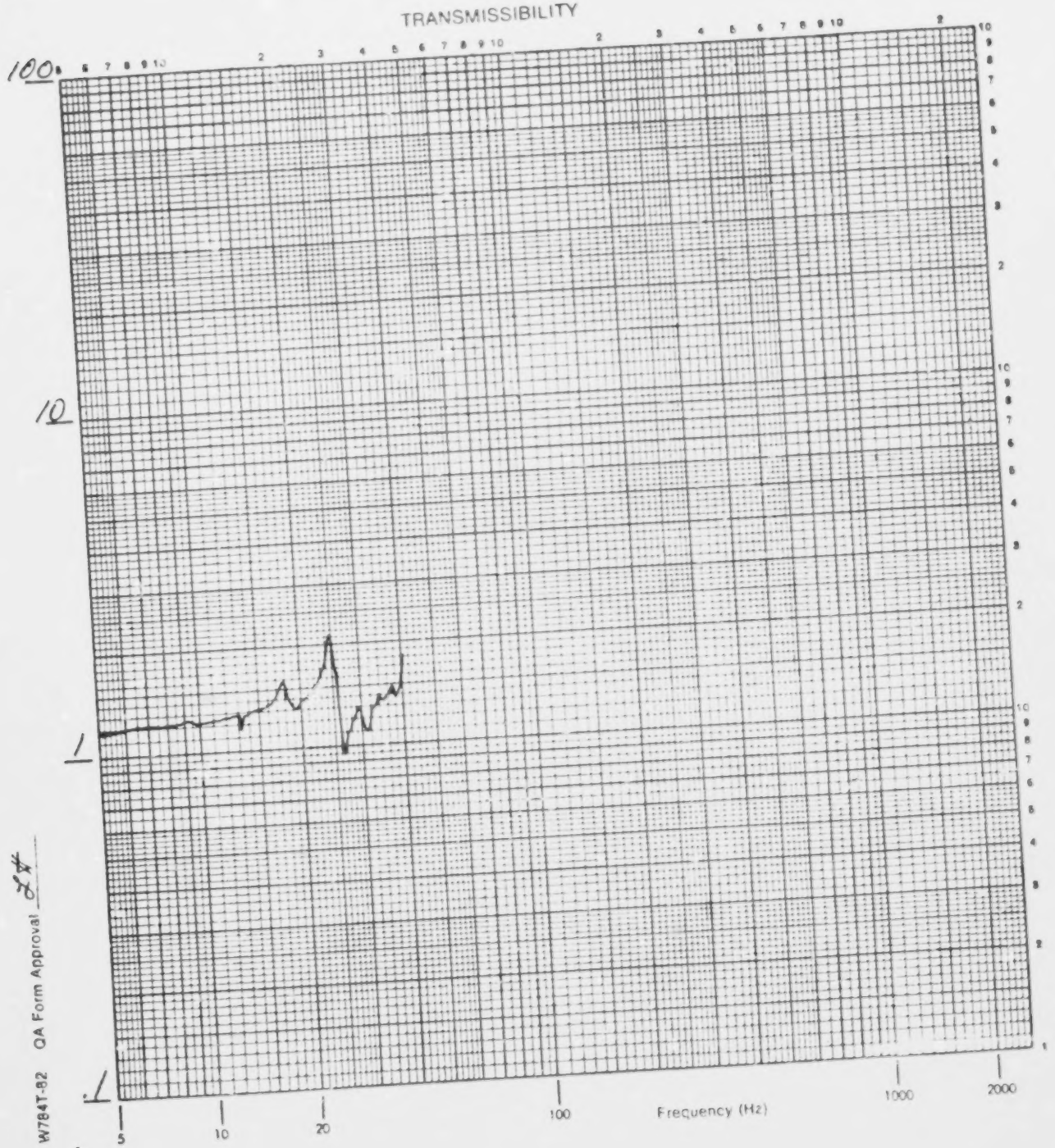
CUSTOMER L.L.N.L. Job No 26447 Date 12-4-85

Specimen MOTOR CONTROL CENTER Test Axis Y Accel No 12/2

Operator GREENERMAN Engineer [illegible] Full Scale 100 G

RUN 34

TRANSMISSIBILITY



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RUN 41

Two bolts per column with no top brace, F-B direction

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LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L Job No 26447 Date 12-5-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 3/1

Operator BRETERMAN Engineer [illegible] Full Scale 100

RUN 41

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

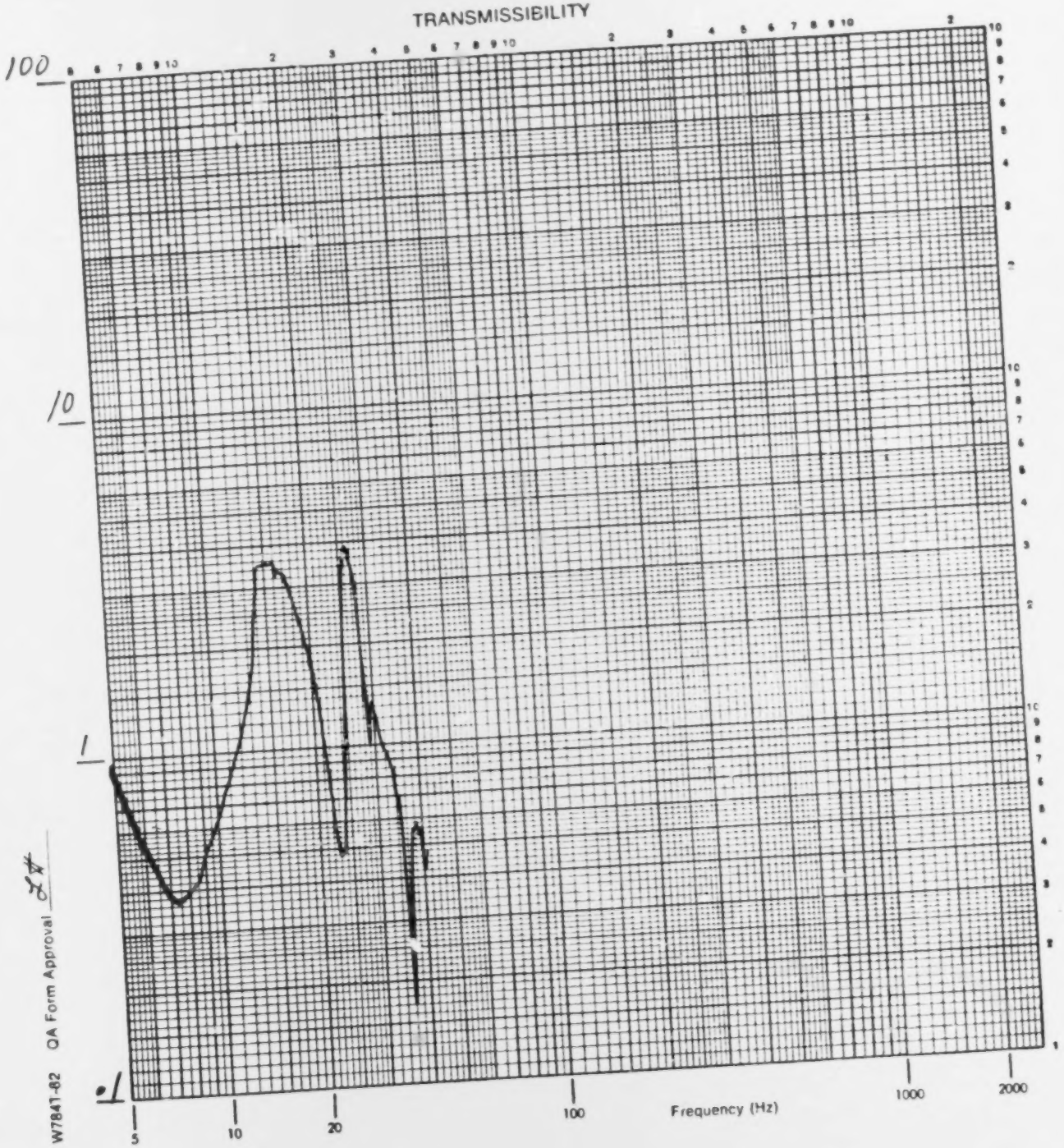
CUSTOMER LLNL Job No 26447 Date 12-5-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 4/1

Operator GREIERMAN Engineer [signature] Full Scale 100 G

RUN 41

TRANSMISSIBILITY



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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER LLNL Job No 26447 Date 12-5-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 5/1

Operator BRETERMAN Engineer Full Scale 100

RUN 41

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

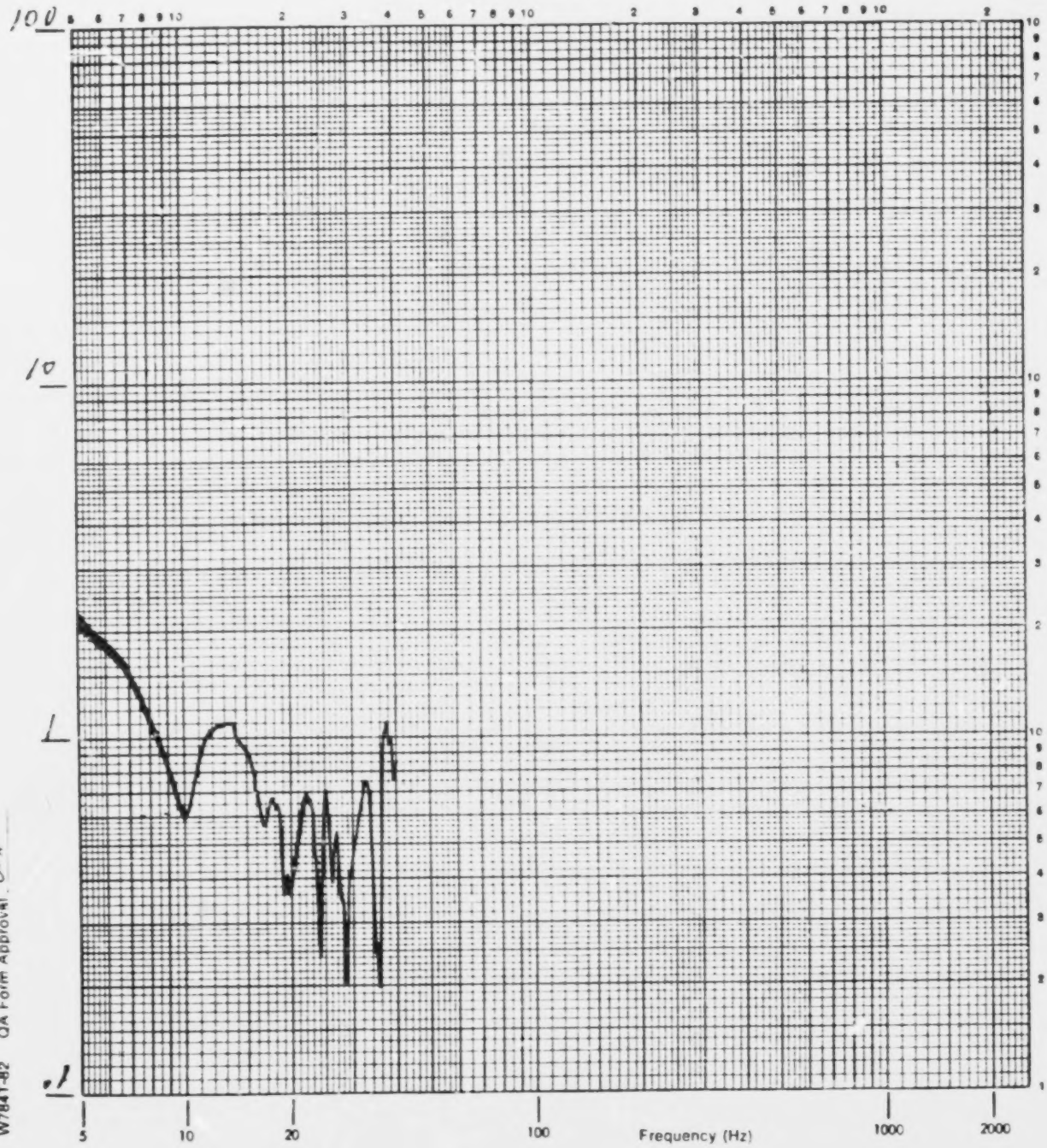
CUSTOMER LLNL Job No 26447 Date 12-5-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 7/1

Operator BRETERMAN Engineer [illegible] Full Scale 100 Q

RUN 41

TRANSMISSIBILITY



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CUSTOMER LLNL Job No 26447 Date 12-5-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No. 8/1

Operator GREENERMAN Engineer [illegible] Full Scale 100 0

RUN 41

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER LLNL Job No 26447 Date 12-5-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 9/1

Operator BRETERMAN Engineer [signature] Full Scale 100 G

RUN 41

TRANSMISSIBILITY

100

10

1

.1

5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2

10 9 8 7 6 5 4 3 2 10 9 8 7 6 5 4 3 2 10 9 8 7 6 5 4 3 2 1

5 10 20 100 Frequency (Hz) 1000 2000

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

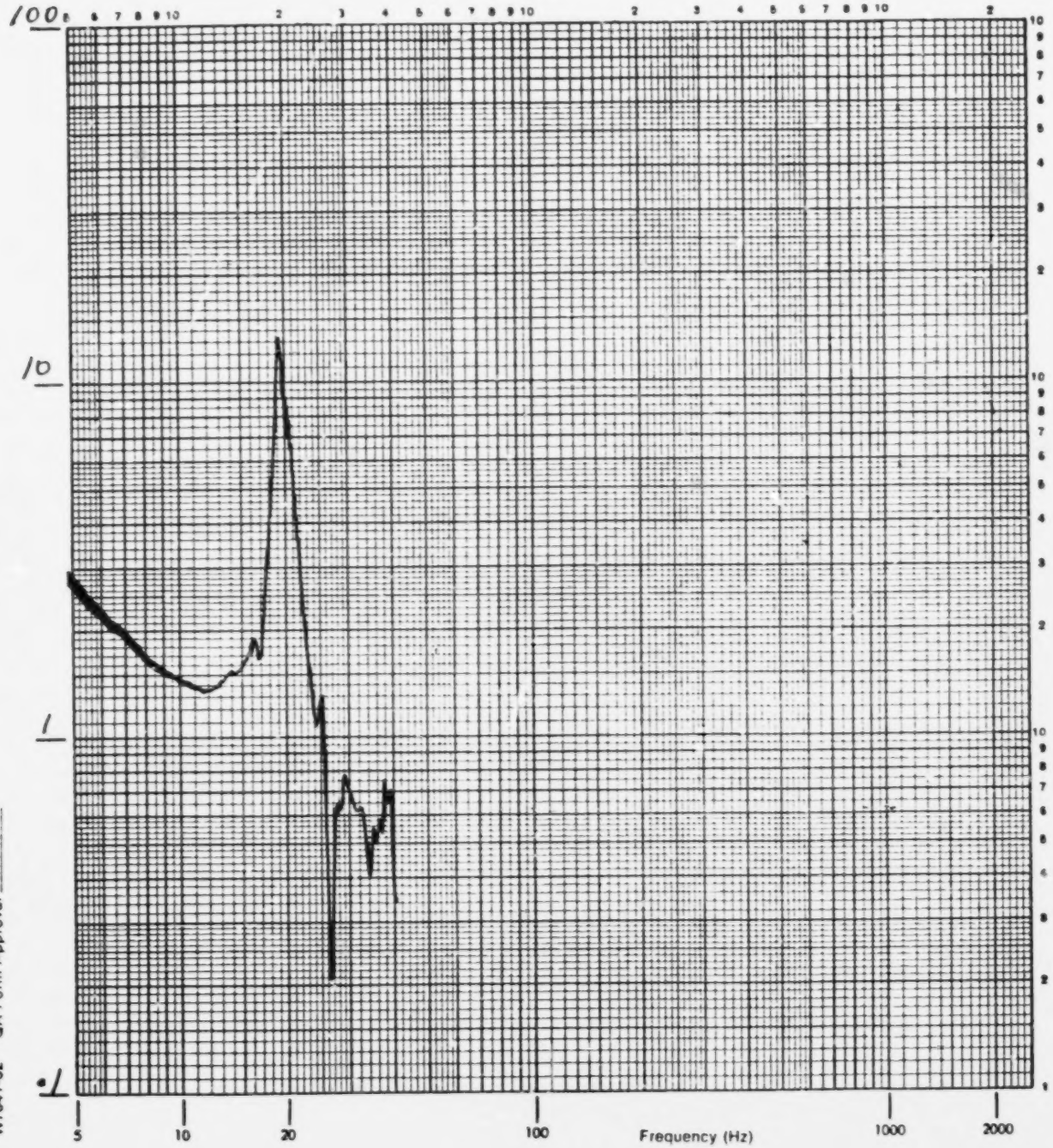
CUSTOMER LLNL Job No 26447 Date 12-5-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 10/1

Operator BRETERMAN Engineer [illegible] Full Scale 100 G

RUN 41

TRANSMISSIBILITY



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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

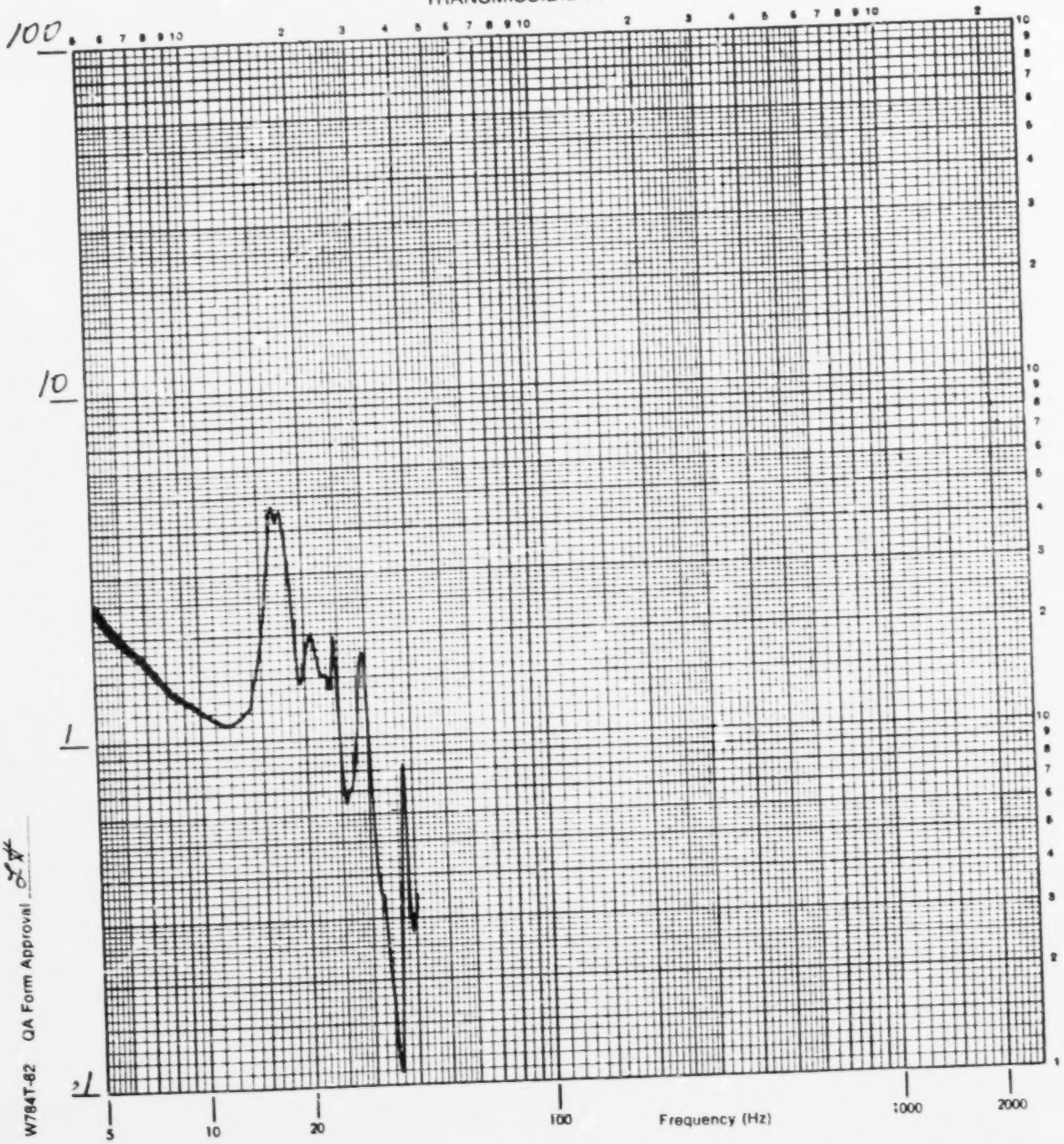
CUSTOMER LLNL Job No. 26447 Date 12-5-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 11/1

Operator GRETERMAN Engineer [signature] Full Scale 100 G

RUN 41

TRANSMISSIBILITY



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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

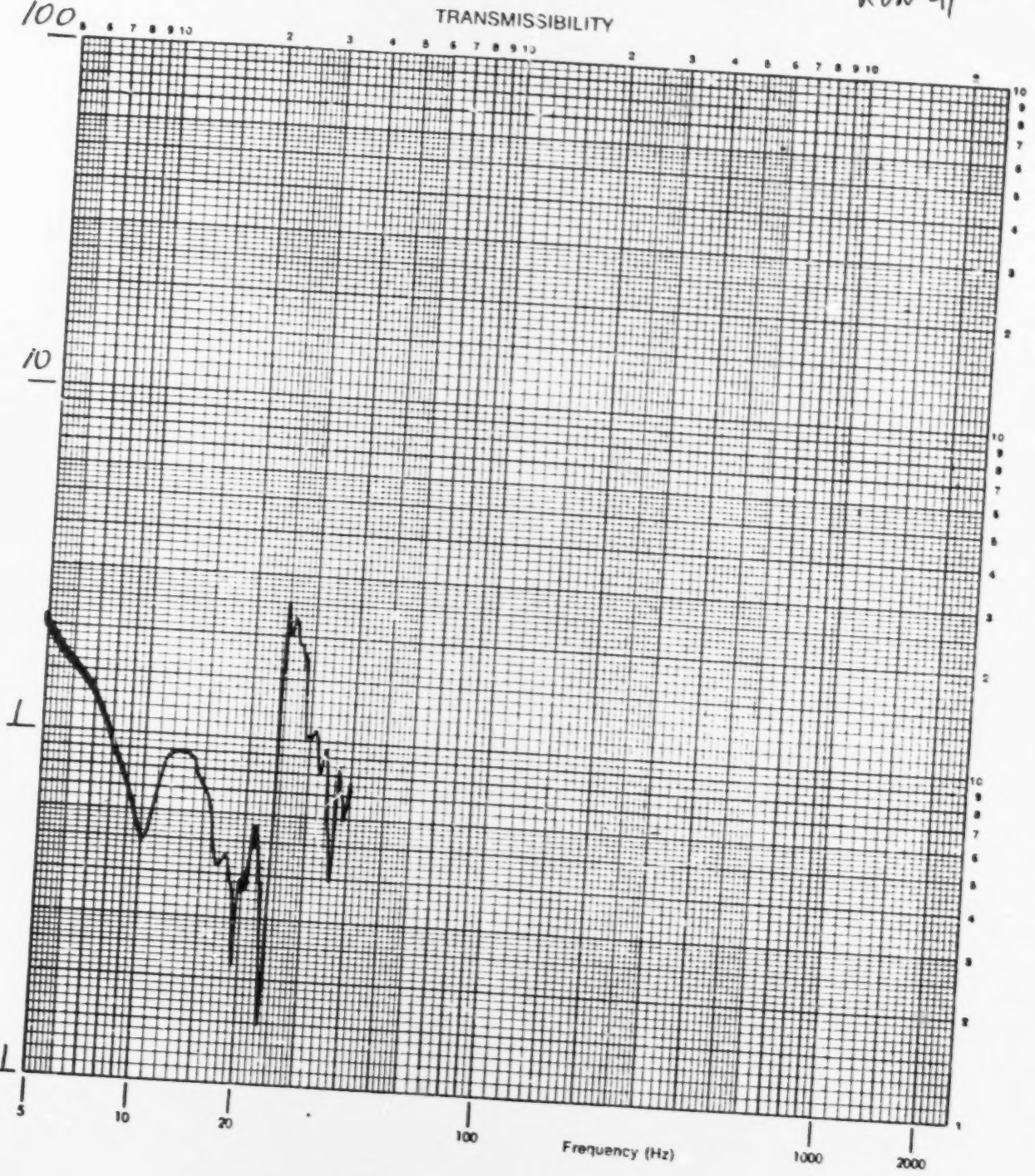
CUSTOMER LLNL

Job No 26447 Date 12-5-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 13/1

Operator GREENERMAN Engineer [illegible] Full Scale 100 Q

RUN 41



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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

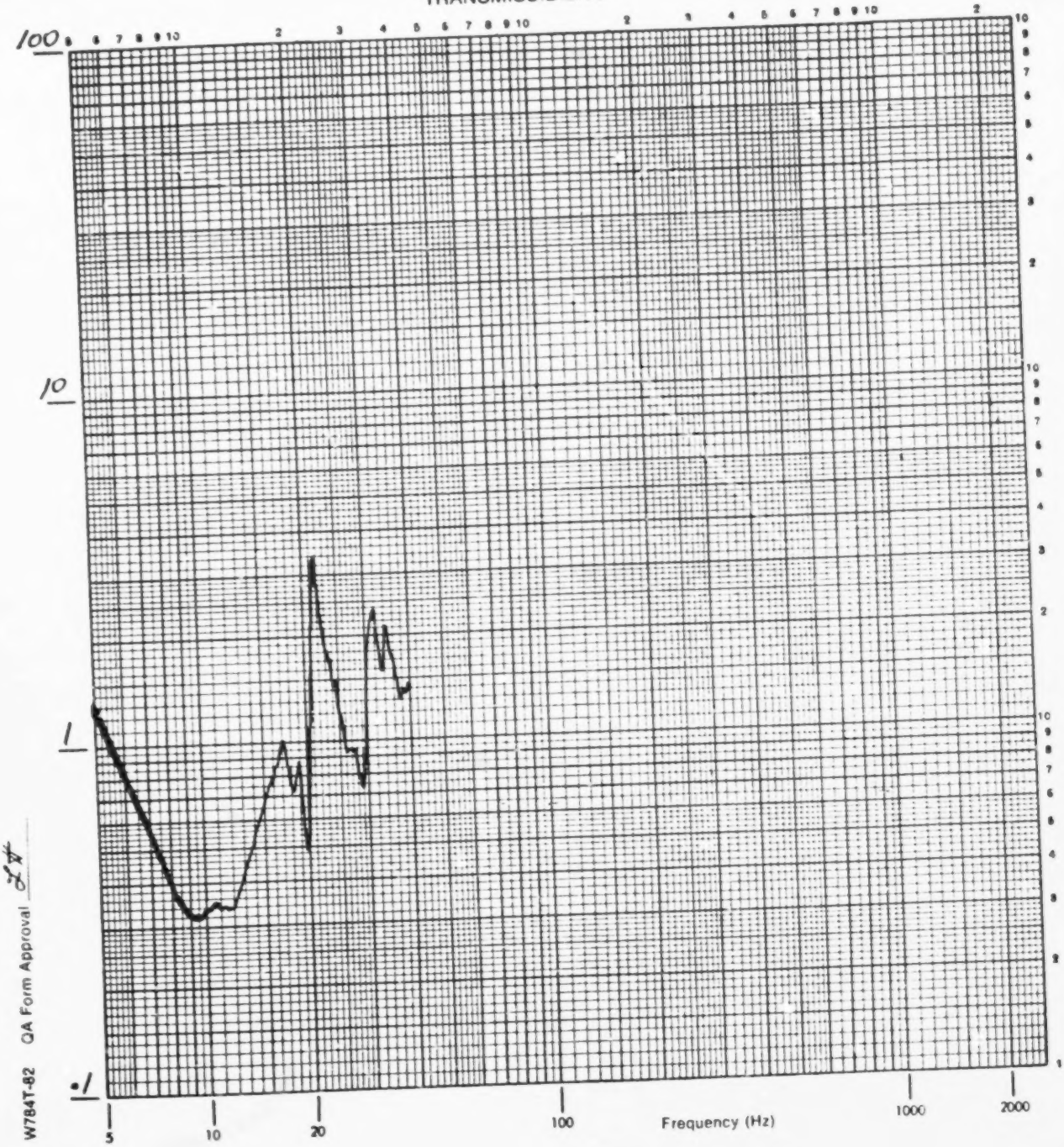
CUSTOMER LLNL Job No. 26447 Date 12-5-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 14/1

Operator GREIERMAN Engineer [signature] Full Scale 100 g

RUN 41

TRANSMISSIBILITY



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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L Job No 26447 Date 12-5-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 15/1

Operator BRETERMAN Engineer [illegible] Full Scale 100 Q

RUN 41

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER LLNL Job No. 26447 Date 12-5-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 16/i

Operator BRETERMAN Engineer [illegible] Full Scale 100 G

RUN 41

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 1000 2000

Frequency (Hz)

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER LLNL Job No 26447 Date 12-5-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 17/1

Operator GRETERMAN Engineer [illegible] Full Scale 100 Q

RUN 41

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 1000 2000

Frequency (Hz)

W784T-82 QA Form Approval [illegible]

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER LLNL Job No. 26447 Date 12-5-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 18/1

Operator GRETERMAN Engineer [signature] Full Scale 100

RUN 41

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

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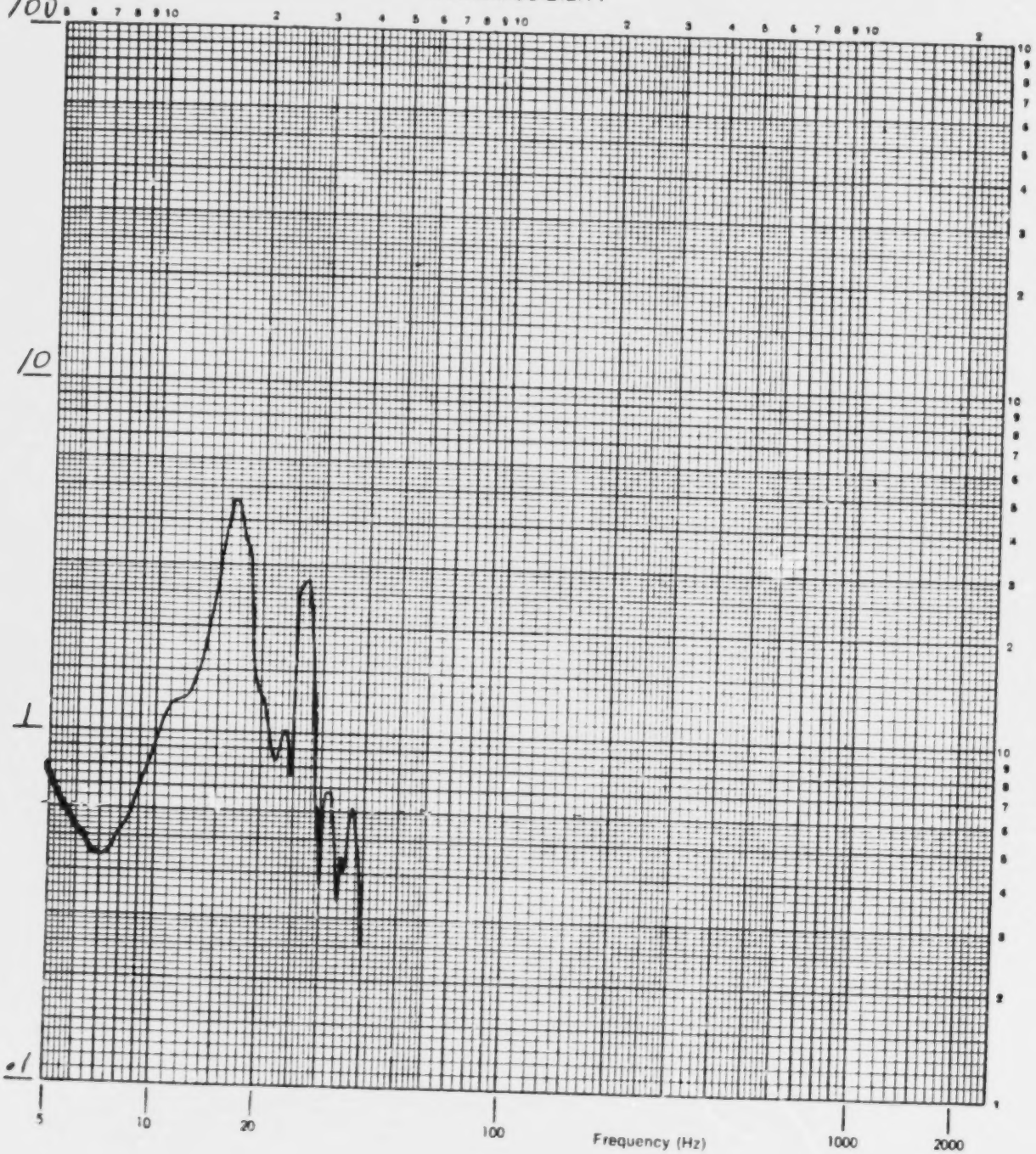
CUSTOMER LLNL Job No 26447 Date 12-5-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 19/1

Operator GREENERMAN Engineer [signature] Full Scale 100 G

RUN 41

TRANSMISSIBILITY



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RUN 47

Four bolts per column with internal bracing, F-B direction

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Report No. 26448

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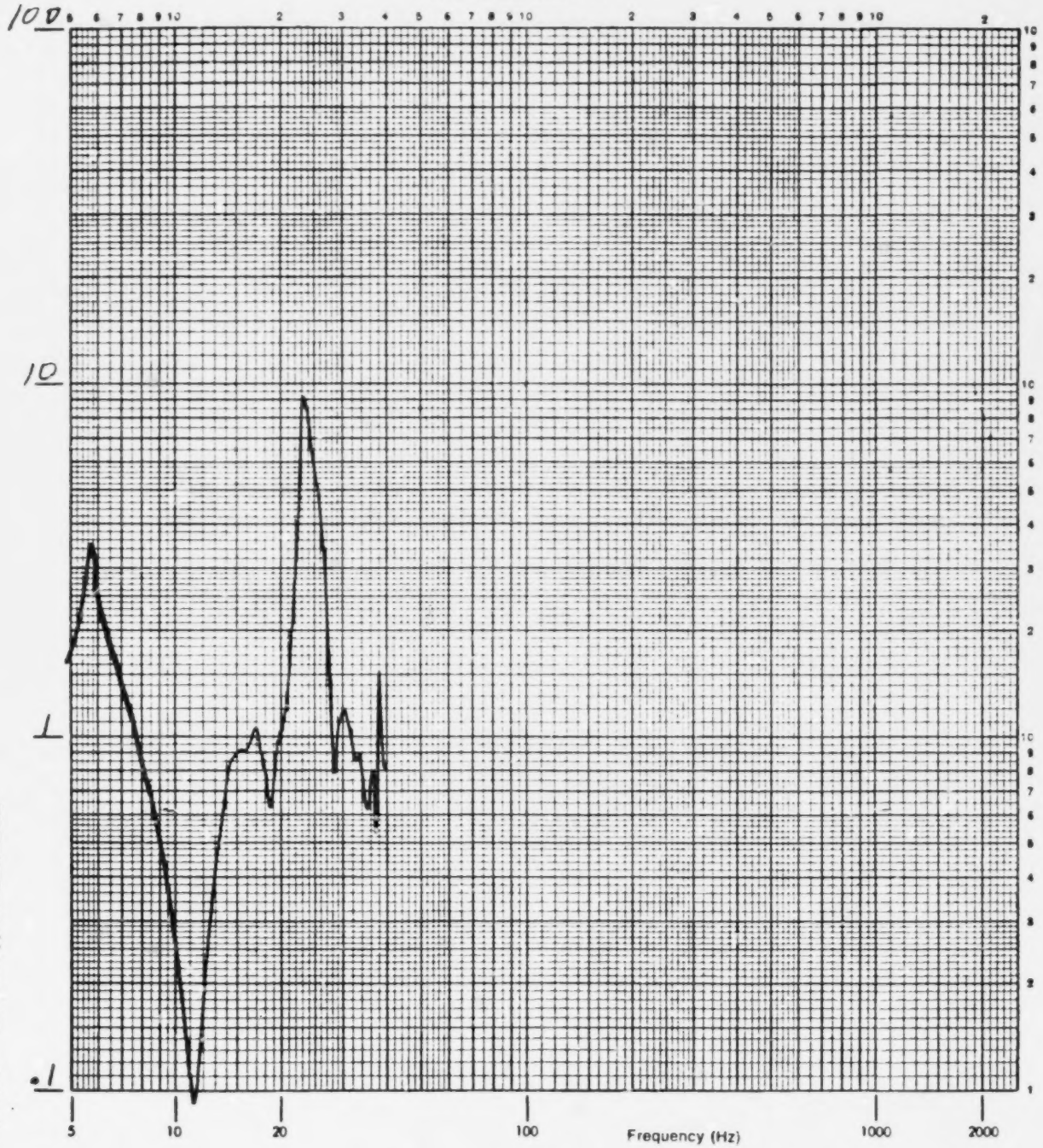
CUSTOMER LLNL Job No 26447 Date 12-6-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 3/1

Operator GREENERMAN Engineer RMM Full Scale 100 G

RUN 47

TRANSMISSIBILITY



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CUSTOMER L.L.N.L. Job No 26447 Date 12-6-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 4/1

Operator GREIERMAN Engineer [signature] Full Scale 100 G

RUN 97

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

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Report No. 26448

CUSTOMER LLNL Job No 26447 Date 12-6-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 5/1

Operator GREIERMAN Engineer [signature] Full Scale 100 G

RUN 97

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

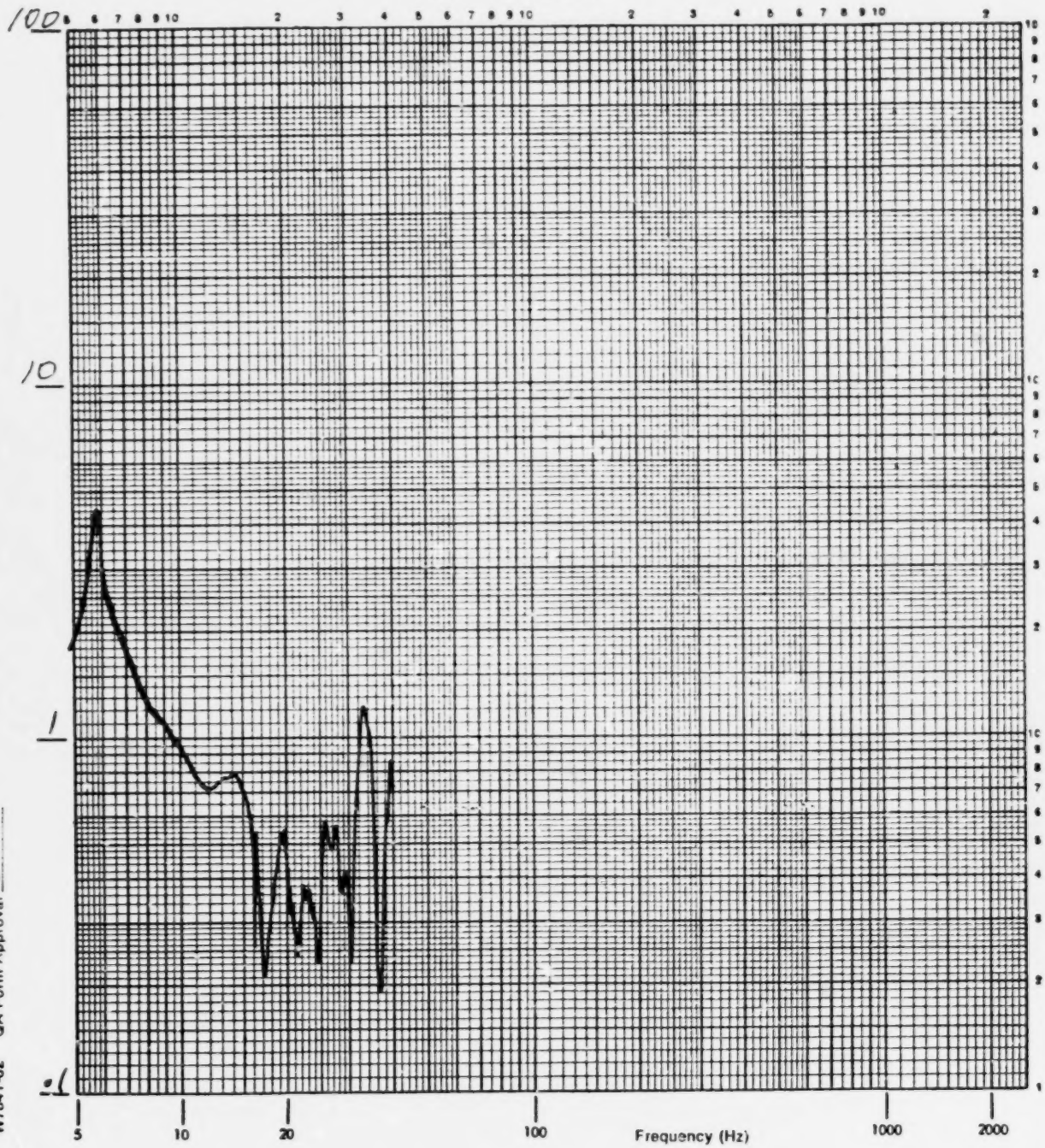
CUSTOMER LLNL Job No 26447 Date 12-6-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 7/1

Operator GREENERMAN Engineer [signature] Full Scale 100 G

RUN 47

TRANSMISSIBILITY



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LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L Job No. 26447 Date 12-6-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No. 8/1

Operator GREIERMAN Engineer [signature] Full Scale 100 G

RUN 47

TRANSMISSIBILITY

100
10
1
.1

5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2

10 9 8 7 6 5 4 3 2 1

5 10 20 100 Frequency (Hz) 1000 2000

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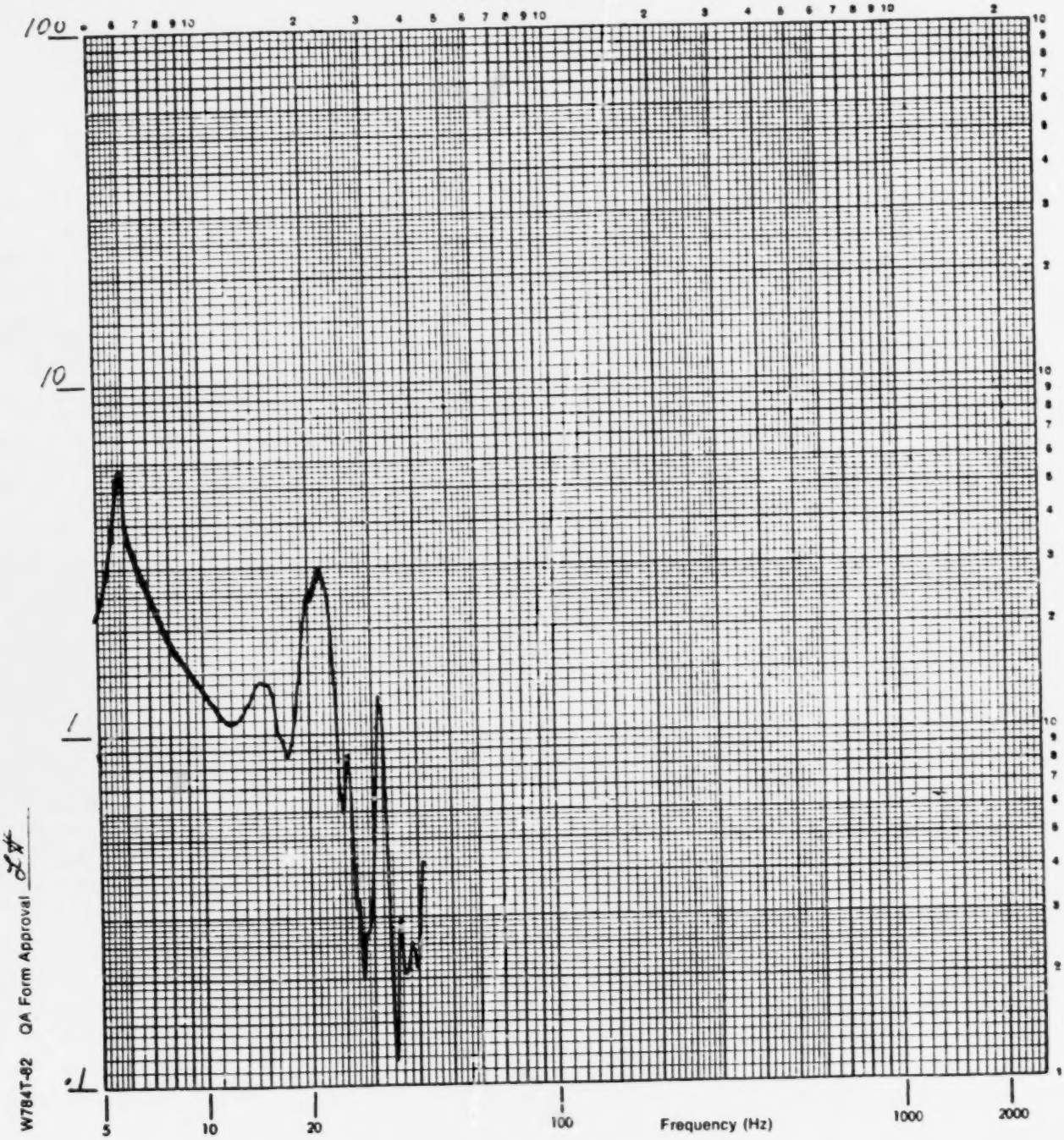
CUSTOMER L.L.N.L Job No 26447 Date 12-6-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No 9/1

Operator GREIERMAN Engineer [signature] Full Scale 100 Q

RUN 47

TRANSMISSIBILITY



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Report No. 26448

Page No. A-106

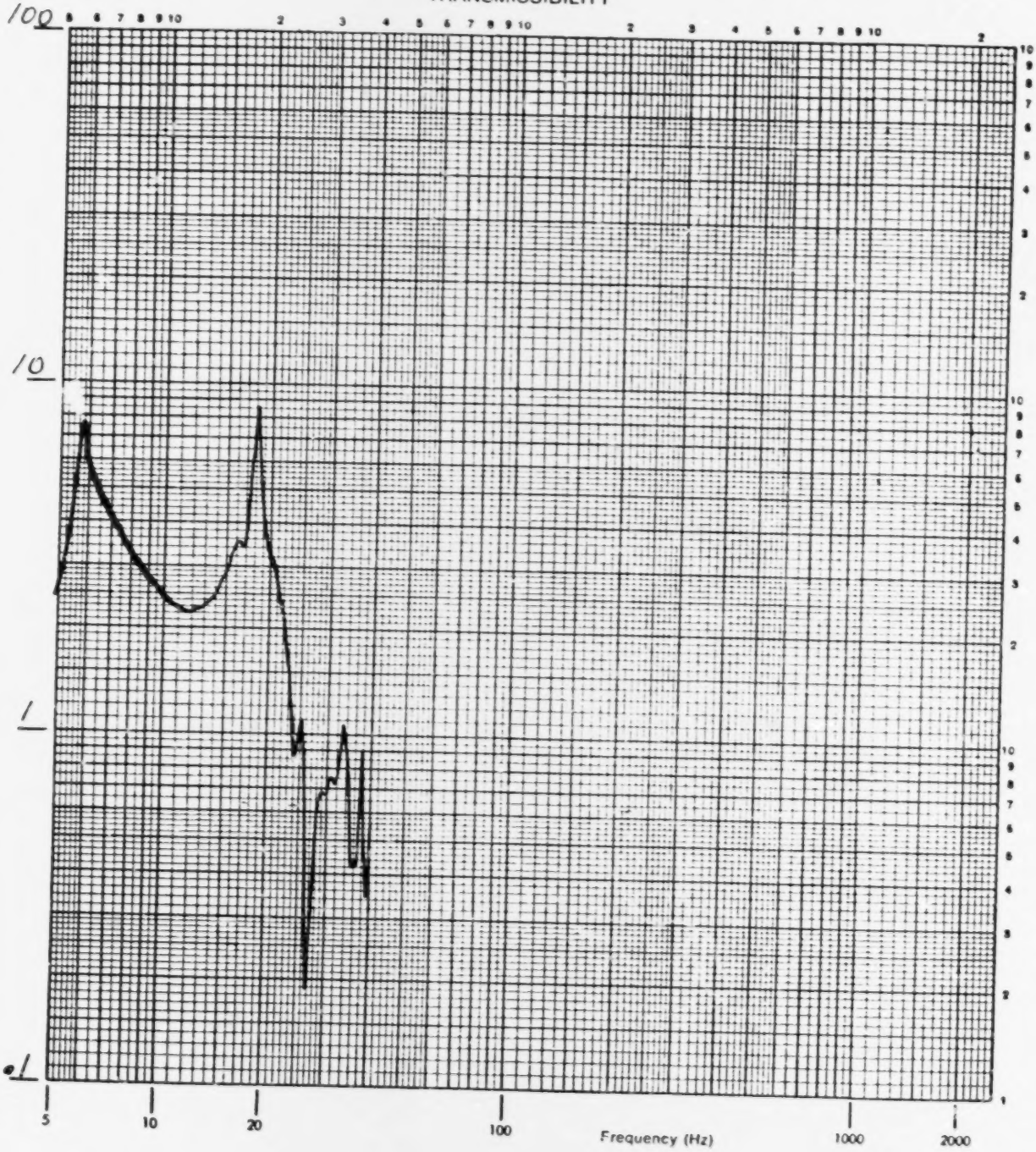
CUSTOMER LLNL Job No 26447 Date 12-6-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 10/1

Operator GRETERMAN Engineer [signature] Full Scale 100 G

RUN 47

TRANSMISSIBILITY



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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L Job No 26447 Date 12-6-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 11/1

Operator GRETERMAN Engineer [signature] Full Scale 100 Q

RUN 47

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

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Page No. A-108

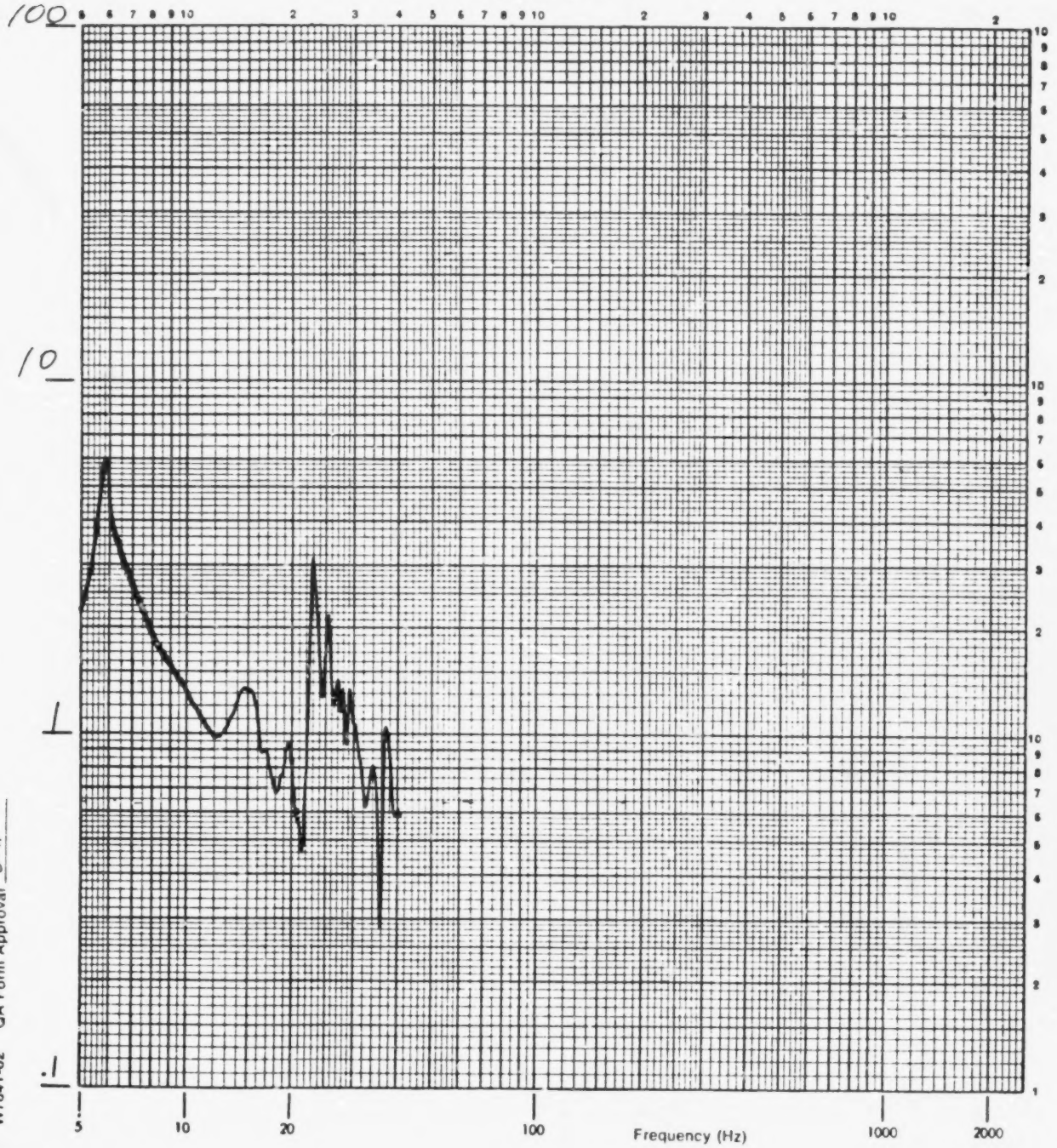
CUSTOMER LLNL Job No. 26447 Date 12-6-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 13/1

Operator GREENERMAN Engineer [signature] Full Scale 100 Q

RUN 47

TRANSMISSIBILITY



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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L Job No. 26447 Date 12-6-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No. 14/1

Operator BRETERMAN Engineer [signature] Full Scale 100 0

RUN 47

TRANSMISSIBILITY

100

10

1

.1

Frequency (Hz)

5 10 20 100 1000 2000

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L Job No. 26447 Date 12-6-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No. 15/1

Operator BRETERMAN Engineer [signature] Full Scale 100 G

RUN 47

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 1000 2000

Frequency (Hz)

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

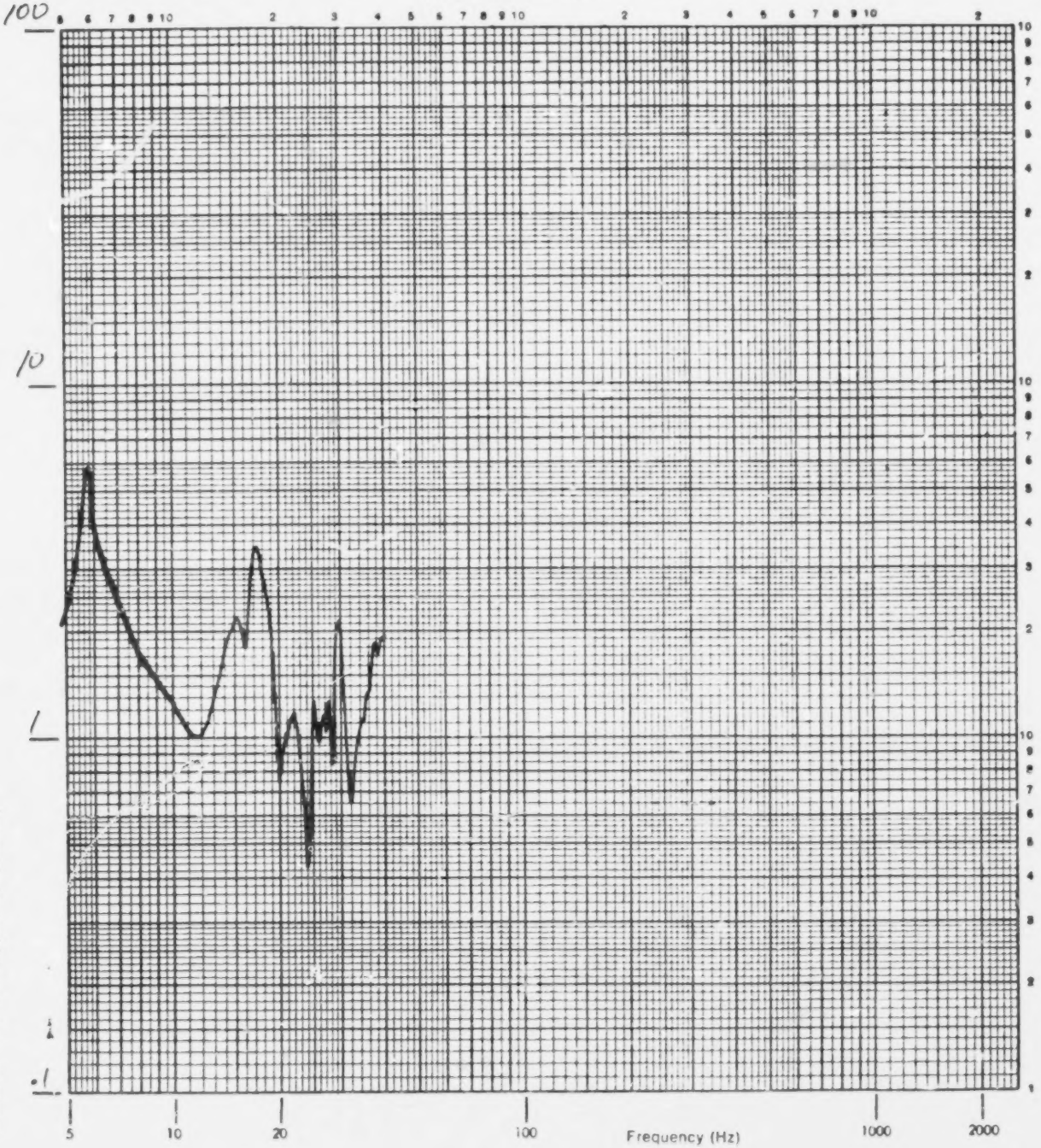
CUSTOMER L.L.N.L Job No 26447 Date 12-6-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 16/1

Operator BREIERMAN Engineer [signature] Full Scale 100 Q

RUN 47

TRANSMISSIBILITY



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WYLE
LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L Job No. 26447 Date 12-6-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 17/1

Operator GREENBERMAN Engineer [signature] Full Scale 100 Q

RUN 47

TRANSMISSIBILITY

100
10
1
.1

5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2

10 9 8 7 6 5 4 3 2 1

5 10 20 100 Frequency (Hz) 1000 2000

W784T-82 QA Form Approval [signature]

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L Job No. 26447 Date 12-6-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 18/1

Operator GREIERMAN Engineer [signature] Full Scale 100 g

RUN 47

TRANSMISSIBILITY

100

10

1

.1

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5 10 20 100 1000 2000

Frequency (Hz)

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LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

Report No. 26448

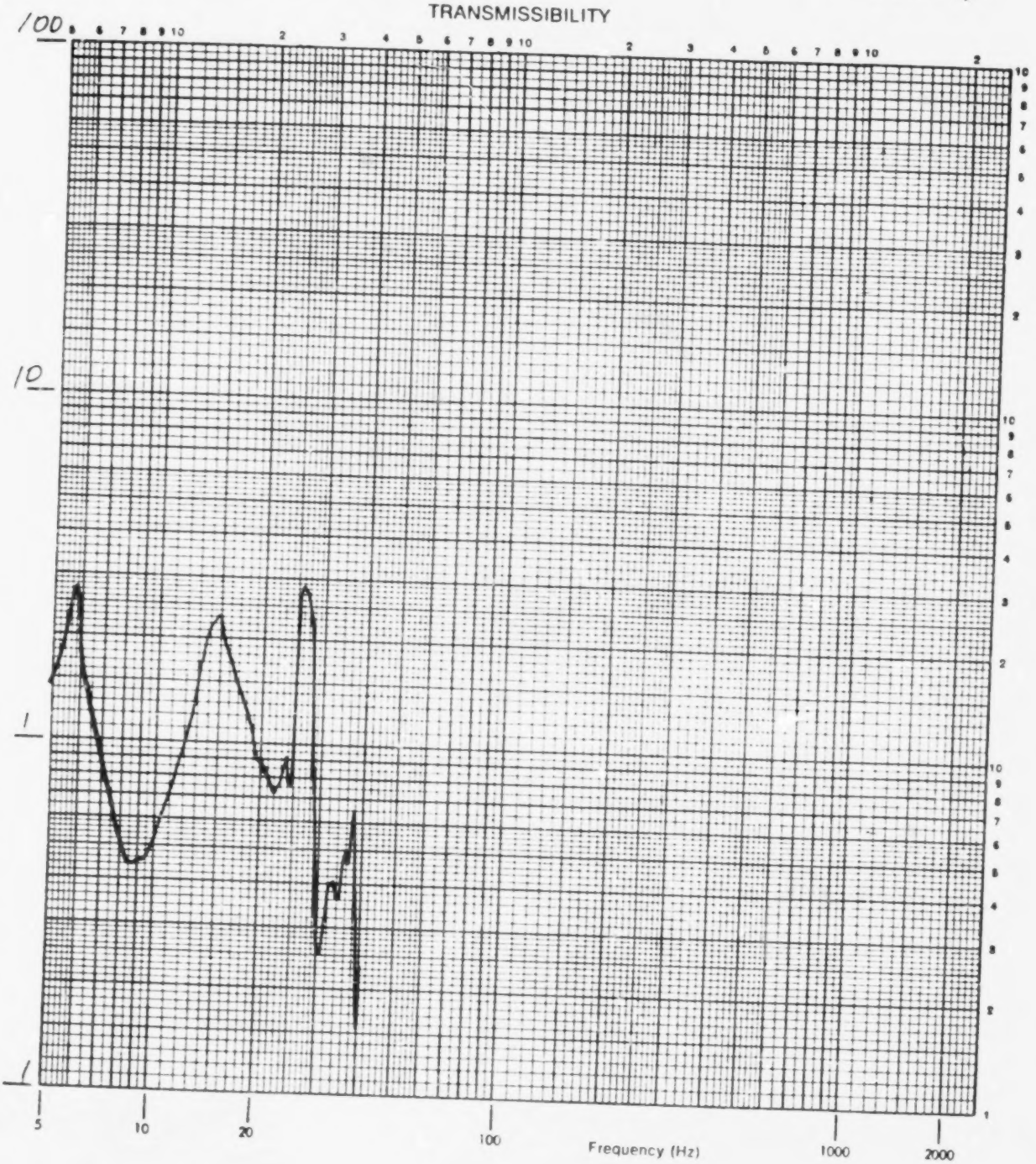
Page No. A-114

CUSTOMER L.L.N.L Job No. 26447 Date 12-6-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No. 19/1

Operator GRETERMAN Engineer [signature] Full Scale 100 Q

RUN 47



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14

RUN 50

Four bolts per column with internal bracing, F-B direction

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

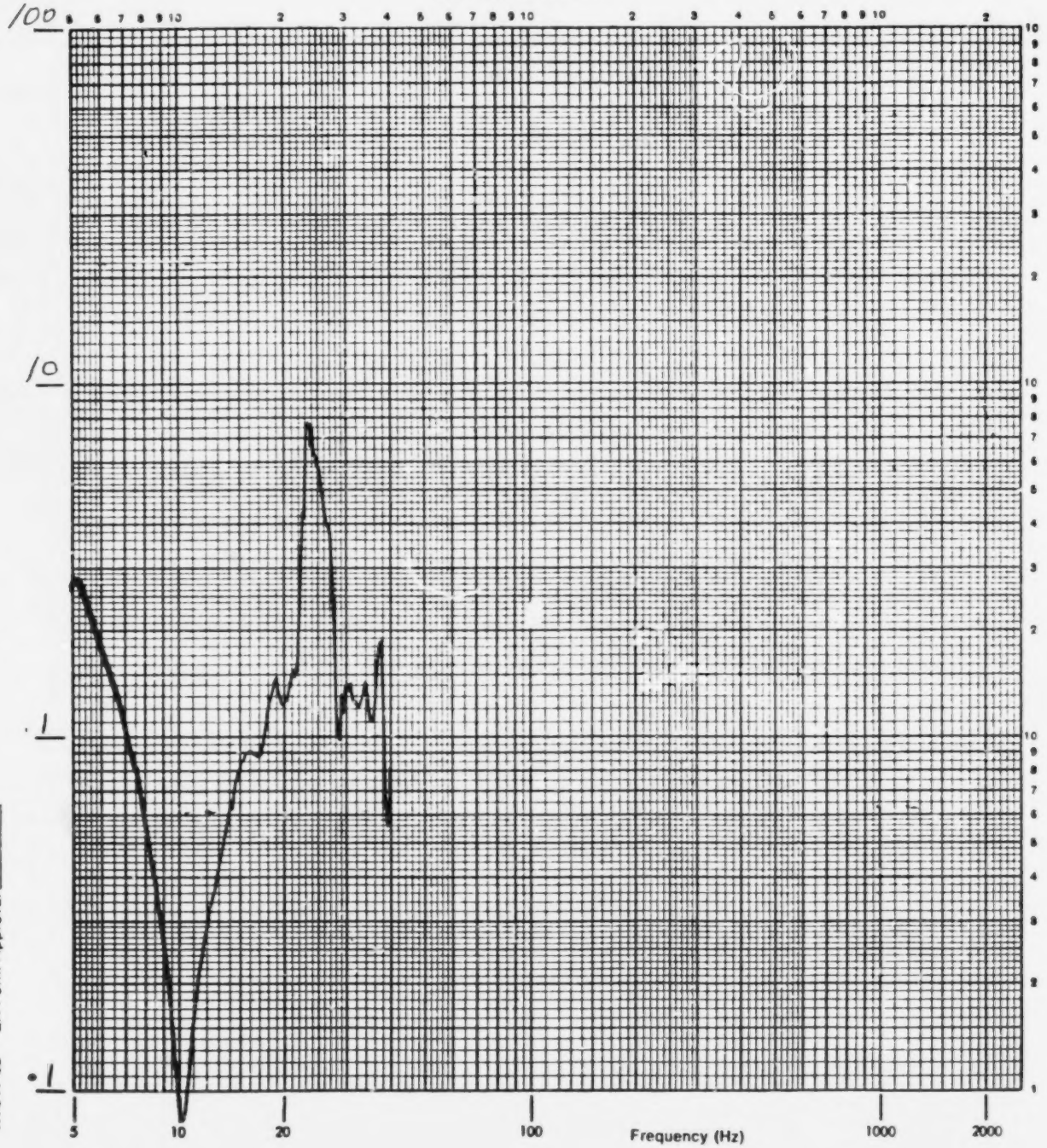
CUSTOMER L.L.N.L Job No 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 3/1

Operator GREIERMAN Engineer [signature] Full Scale 100 Q

RUN 50

TRANSMISSIBILITY



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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L. Job No. 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 4/1

Operator GREENMAN Engineer [signature] Full Scale 100

RUN 50

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

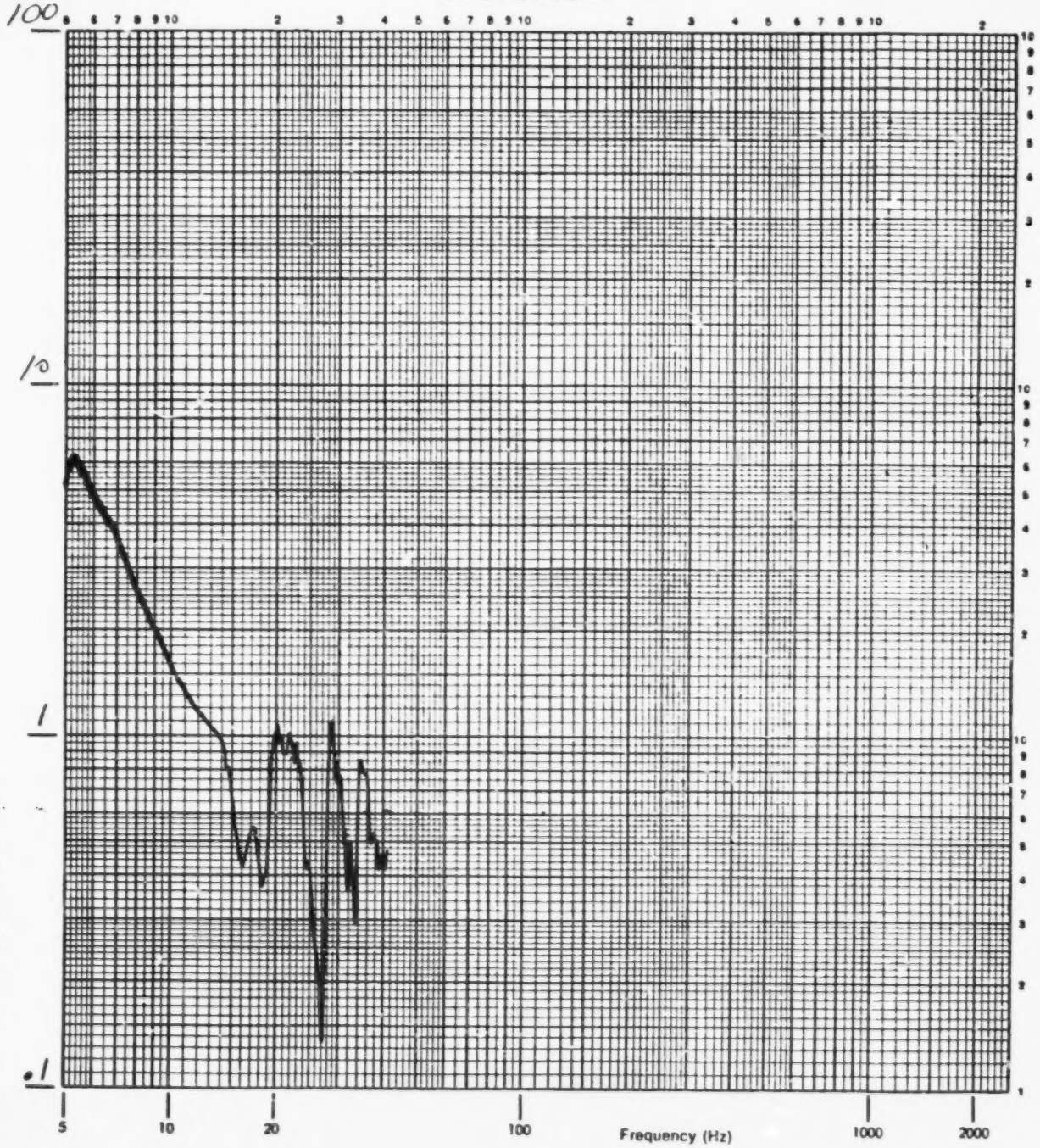
CUSTOMER L·L·N·L Job No 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 5/1

Operator GREENERMAN Engineer [signature] Full Scale 100 Q

RUN 50

TRANSMISSIBILITY



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Report No. 26448

Page No. A-118

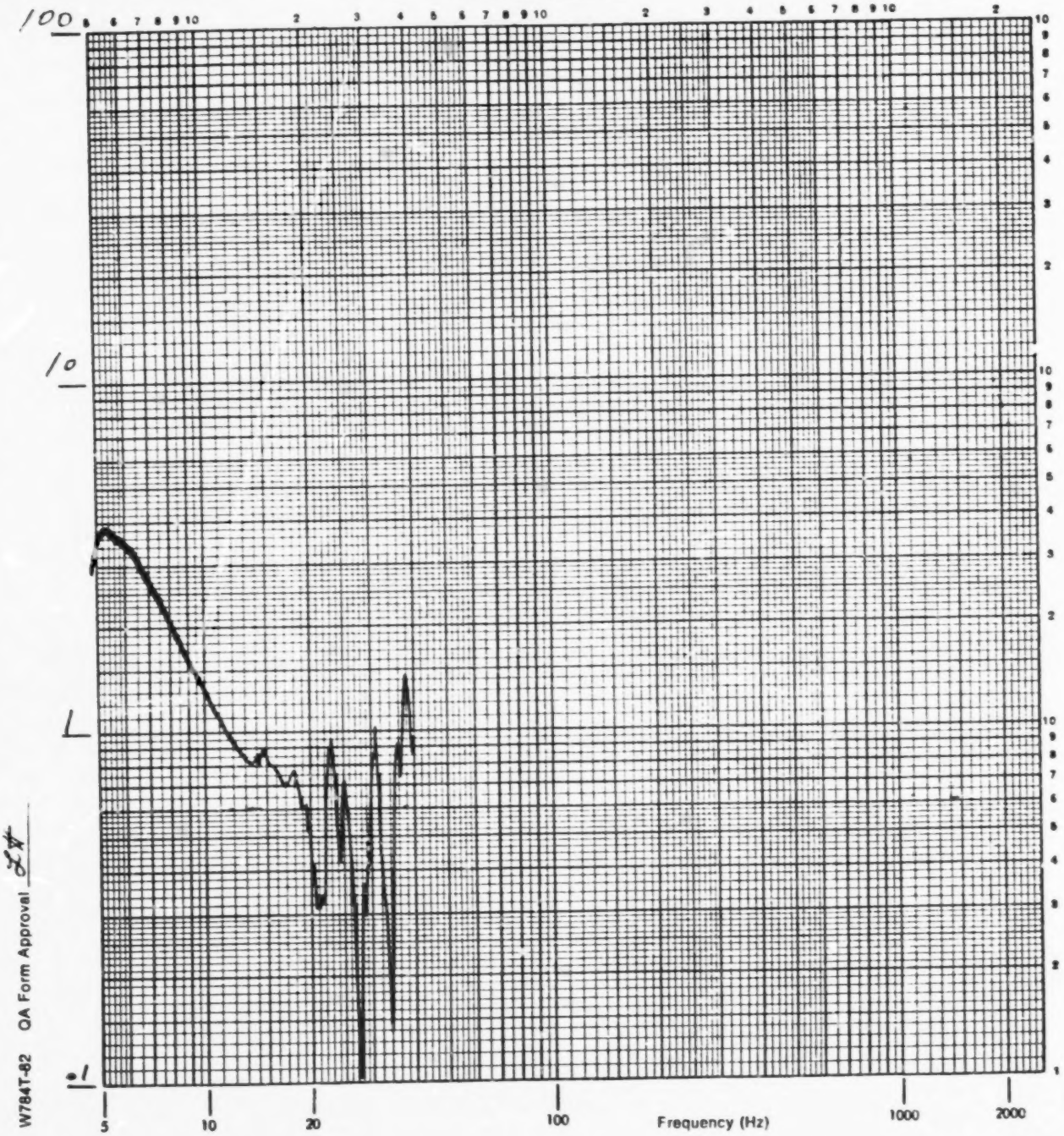
CUSTOMER L.L.N.L Job No. 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 7/1

Operator GREIERMAN Engineer _____ Full Scale 100 G

RUN 50

TRANSMISSIBILITY



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145

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CUSTOMER L.L.N.L Job No 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Test Axis Accel No. 6/1

Operator BRETERMAN Engineer Full Scale 100 Q

RUN 50

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L Job No. 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 9/1

Operator GREENMAN Engineer [signature] Full Scale 100 g

RUN 50

TRANSMISSIBILITY

100

10

1

.1

5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2

10 9 8 7 6 5 4 3 2

5 10 20 100 Frequency (Hz) 1000 2000

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Report No. 26448

Page No. A-121

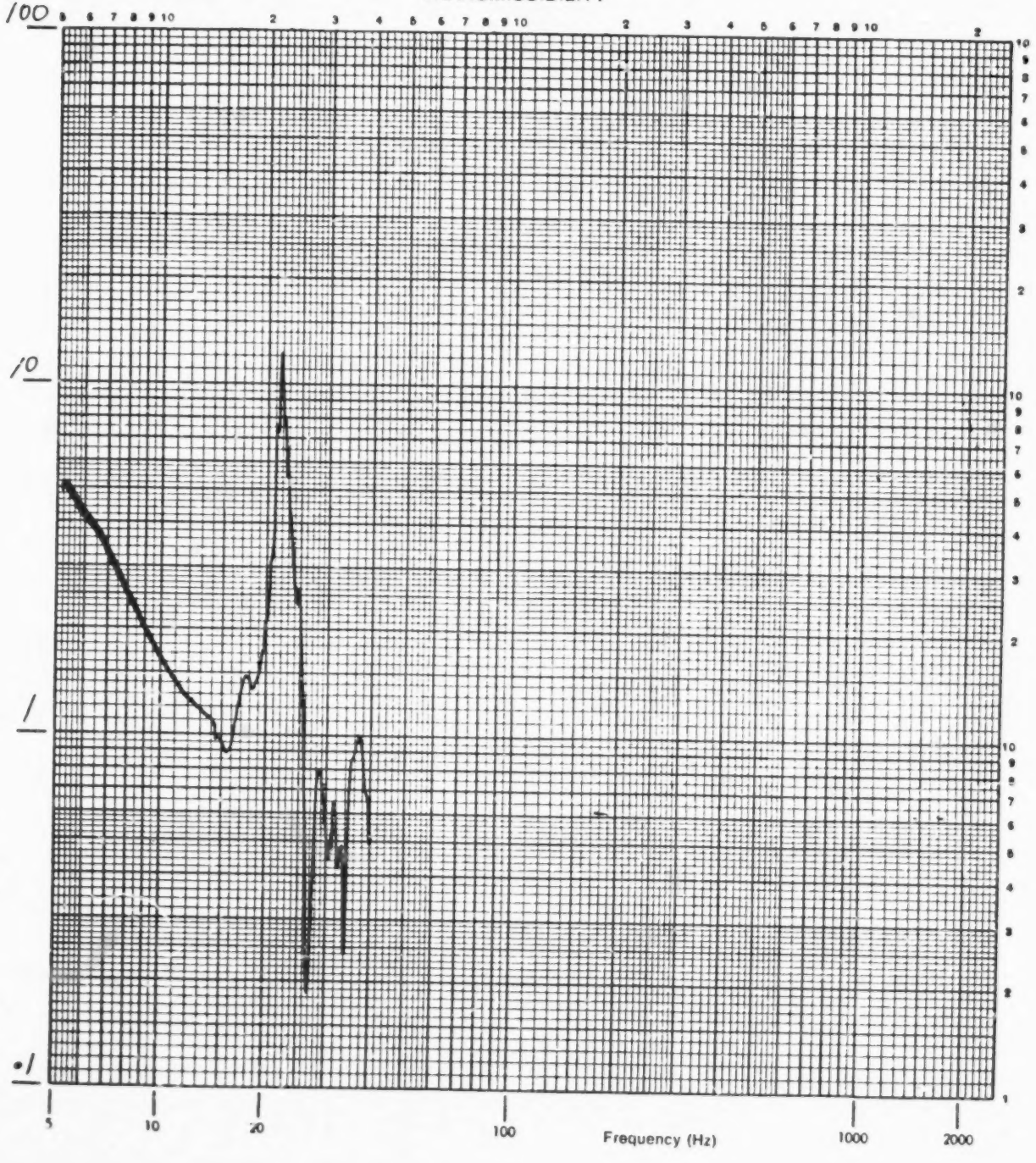
CUSTOMER L.L.N.L. Job No. 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 10/1

Operator GREENERMAN Engineer [signature] Full Scale 100 G

RUN 50

TRANSMISSIBILITY



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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L Job No. 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 11/1

Operator GREENERMAN Engineer [signature] Full Scale 100 G

RUN 50

TRANSMISSIBILITY

100

10

1

.1

5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2 3 4 5 6 7 8 9 10 2

10 9 8 7 6 5 4 3 2 10 9 8 7 6 5 4 3 2 10 9 8 7 6 5 4 3 2 1

5 10 20 100 Frequency (Hz) 1000 2000

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L Job No 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 13/1

Operator EREIERMAN Engineer [signature] Full Scale 100

RUN 50

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

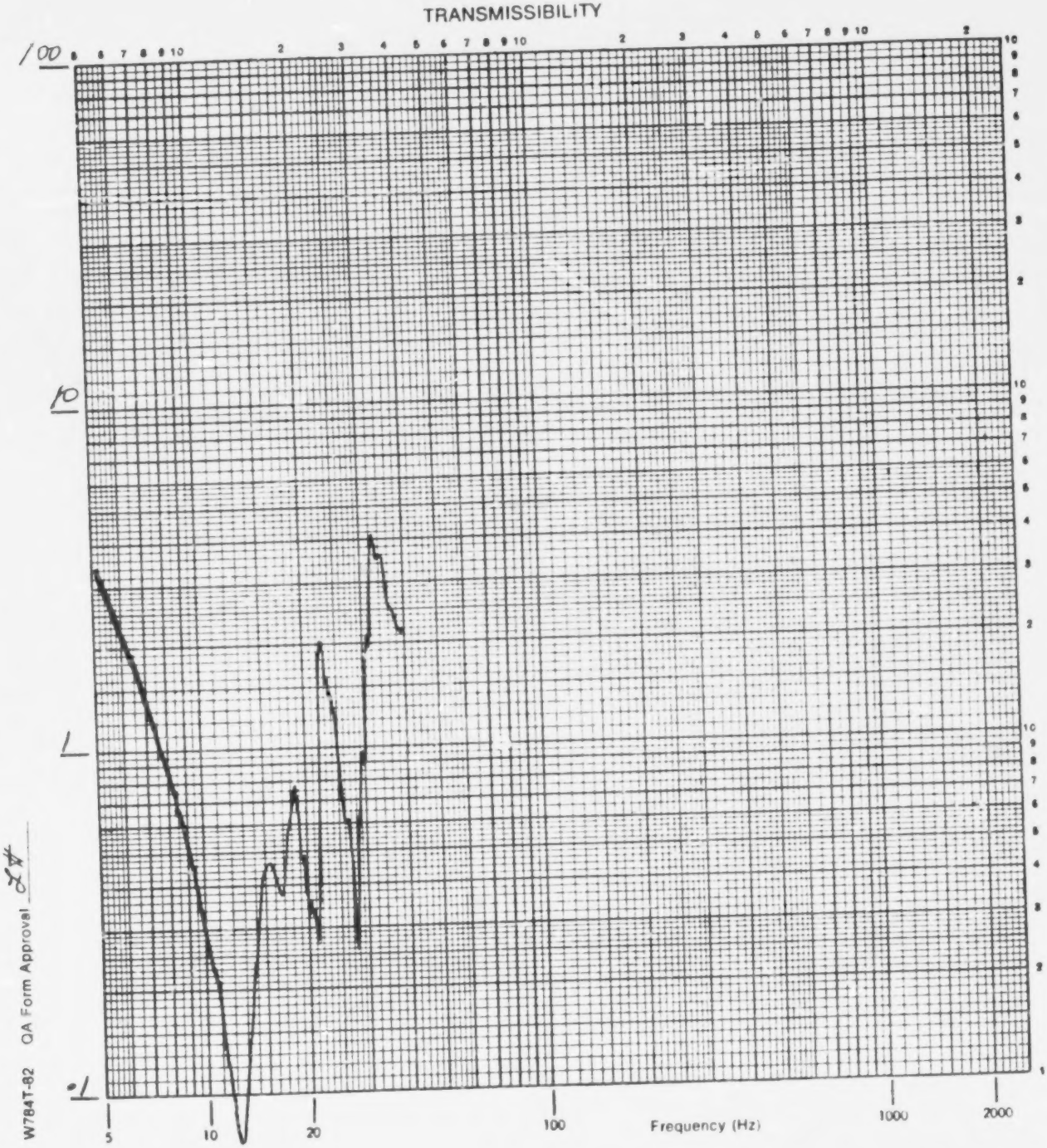
CUSTOMER L.L.N.L. Job No. 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 14/1

Operator GREIERMAN Engineer [signature] Full Scale 100 G

RUN 50

TRANSMISSIBILITY



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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L Job No 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 15/1

Operator GREENERMAN Engineer [signature] Full Scale 100 Q

RUN 50

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 1000 2000

Frequency (Hz)

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

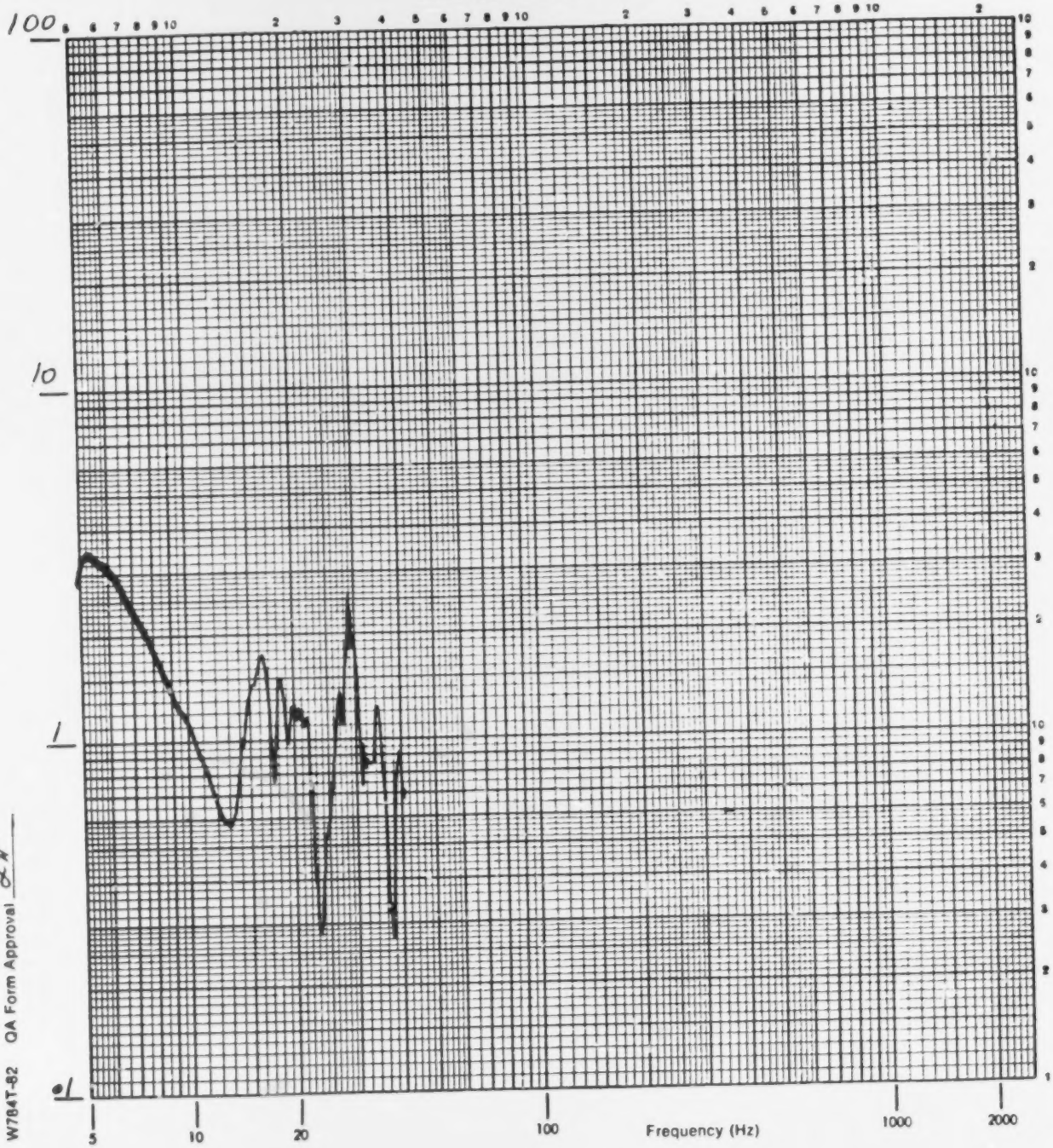
CUSTOMER L.L.N.L. Job No 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 16/1

Operator GREENMAN Engineer [signature] Full Scale 100 Q

RUN 50

TRANSMISSIBILITY



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CUSTOMER L.L.N.L. Job No. 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No 17/1

Operator BRETERMAN Engineer [signature] Full Scale 100 Q

RUN 50

TRANSMISSIBILITY

100 10 1 .1

5 10 20 100 1000 2000

Frequency (Hz)

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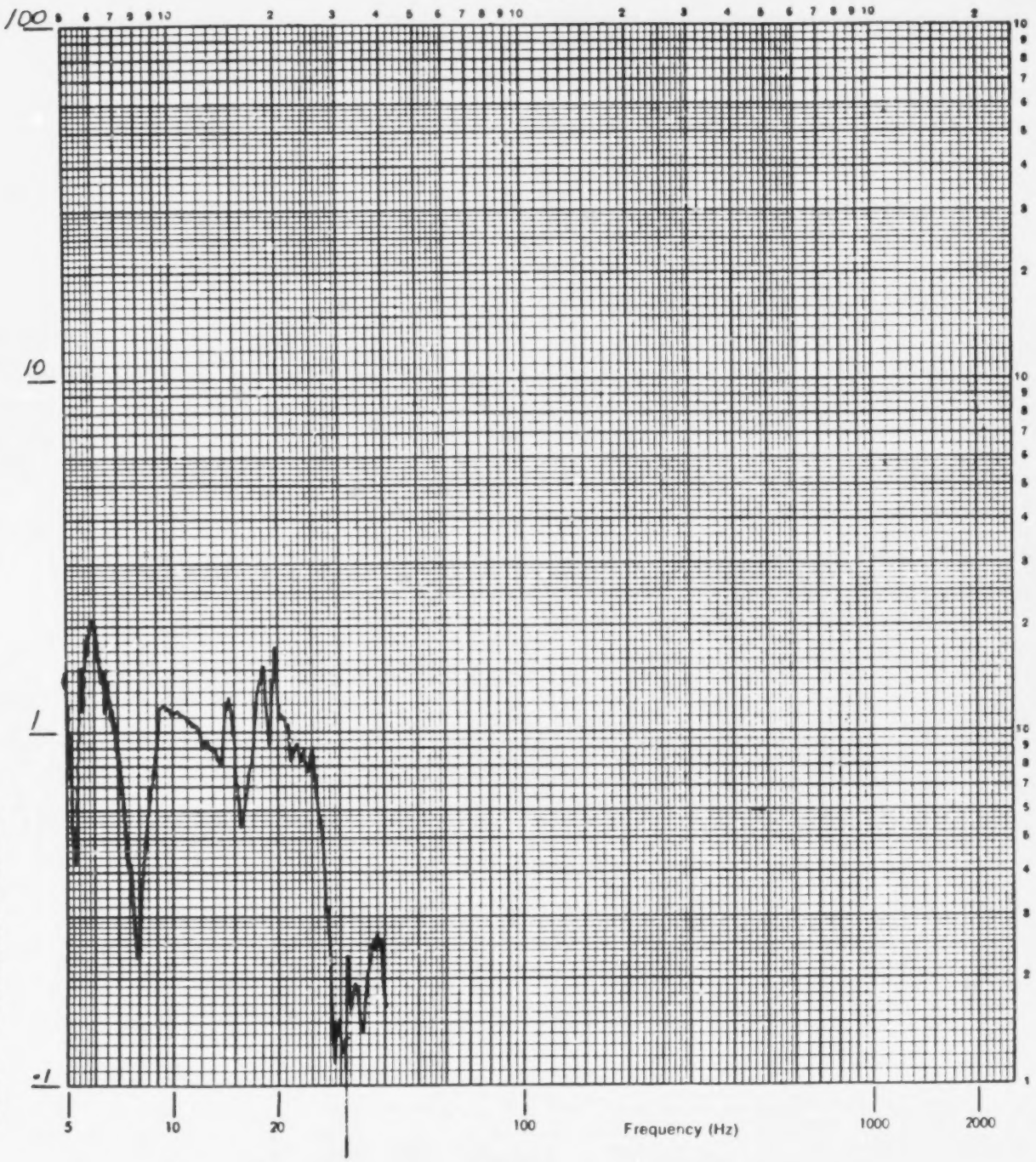
CUSTOMER L.L.N.L Job No. 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel No. 18/1

Operator GREIERMAN Engineer [signature] Full Scale 100 Q

RUN 50

TRANSMISSIBILITY



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CUSTOMER L.L.N.L Job No. 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Test Axis X Accel. No. 19/1

Operator GREENMAN Engineer [signature] Full Scale 100 G

RUN 50

TRANSMISSIBILITY

100

10

1

.1

5 10 20 100 Frequency (Hz) 1000 2000

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RUN 51

Four bolts per column with internal bracing, vertical direction

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LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

Report No. 26448

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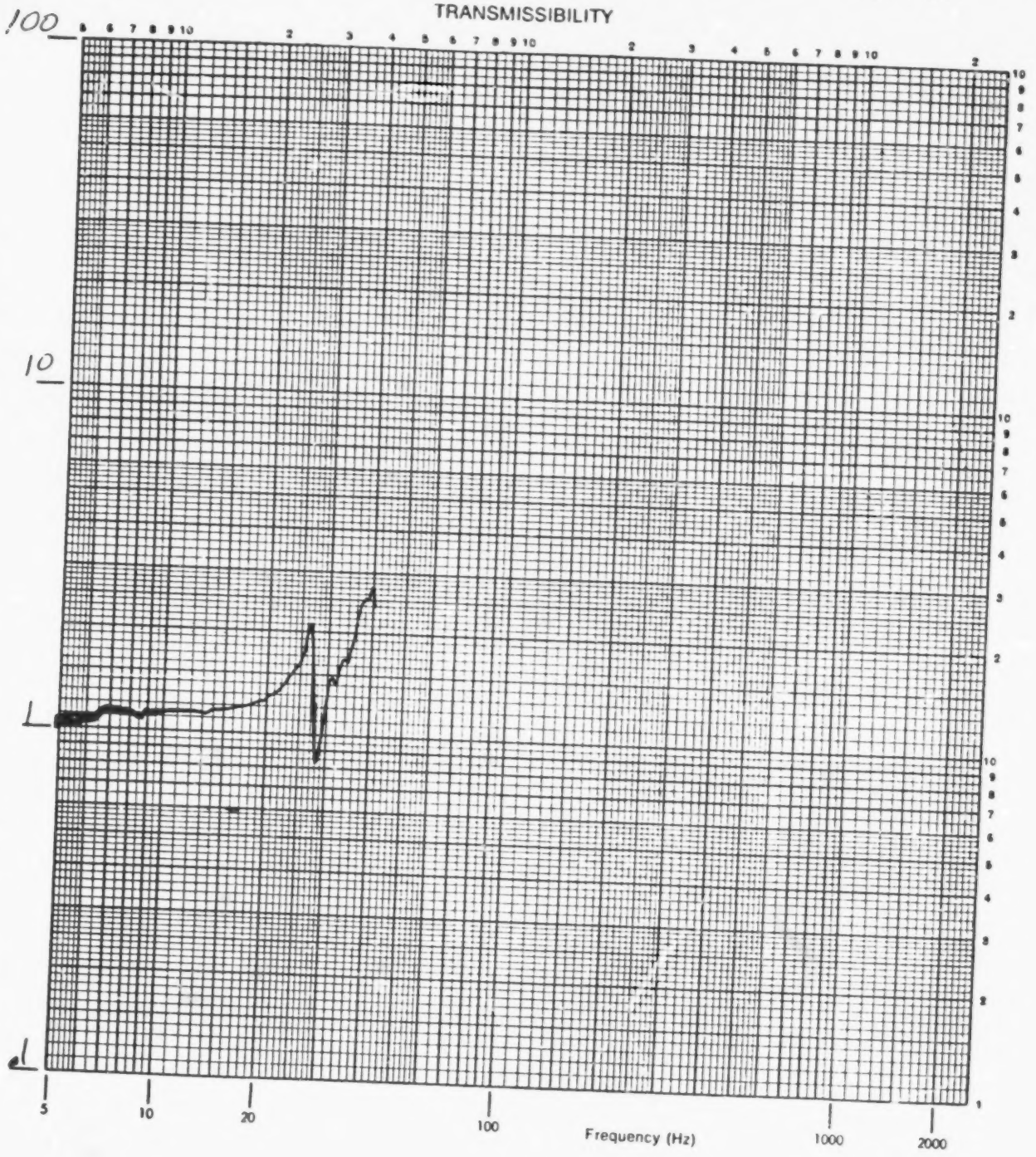
CUSTOMER L.L.N.L Job No. 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Test Axis Y Accel No. 12/2

Operator GREENERMAN Engineer [signature] Full Scale 100 G

RUN 51



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Report No. 26448

Page No. A-131

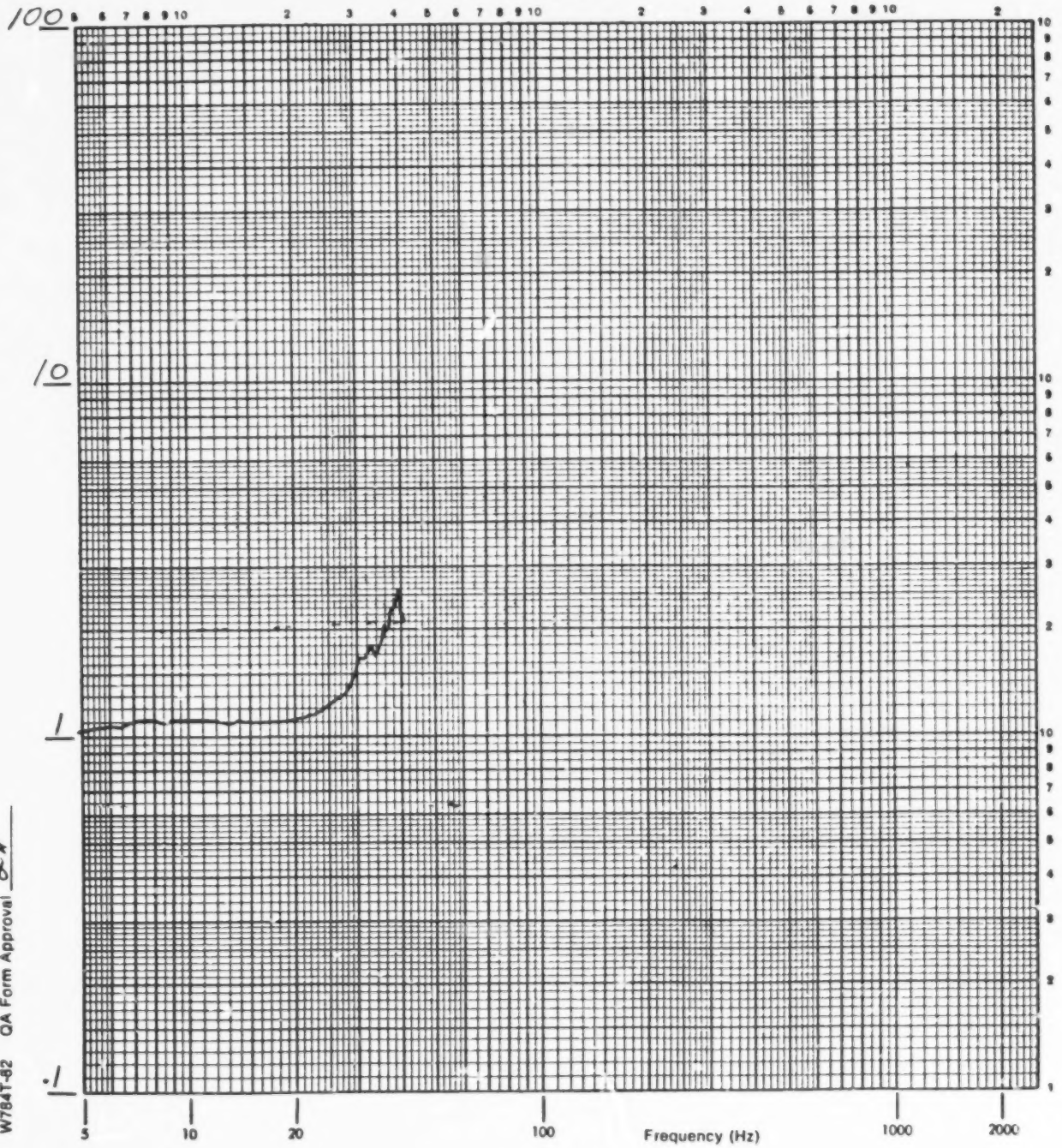
CUSTOMER L.L.N.L Job No 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Test Axis Y Accel No 6/2

Operator GREIERMAN Engineer [signature] Full Scale 100 G

RUN 51

TRANSMISSIBILITY



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APPENDIX C

Time-History Data from Runs 17, 31, 46, and 56

APPENDIX C

This appendix presents chatter detector output and time-history plots from Runs 17, 31, 46, and 56 showing contact chatter, times of occurrence, and the corresponding in-cabinet excitation waveform for each device. In these tests, the MCC was subjected to the most severe input motion applied to each mounting configuration with horizontal table input (in each case oriented in the F-B cabinet direction) ranging from 2.1 to 2.5g ZPA. Figure C-1 provides annotated sample plots and a legend to aid in their interpretation.

Equivalent time-history information for all runs is included in the final test report submitted to LLNL by Wyle Laboratories.*

---

*Wyle Laboratories, Scientific Services and Systems Group, Seismic Fragility Evaluation of a Motor Control Center for Lawrence Livermore National Laboratory (May 1986).

X-Y Axis	=	Front-to-Back/Vertical
Z-Y Axis	=	Side-to-Side/Vertical

OFF-ON FW	=	De-energized - energized sequence, FW starter active
ON-OFF RV	=	Energized - de-energized sequence, RV starter active

Third column indicates the beginning and end of time period over which chatter (or bouncing) occurred.

Channel ID

1st 2 digits = position in MCC

NO	Starter	normally open auxilliary contact
NC		normally closed auxilliary contact
AMPS		main contact
FW NO	Starter	NO forward auxilliary contact
FW NC		NC forward auxilliary contact
RV NO		NO reverse auxilliary contact
RV NC		NO reverse auxilliary contact
AMPS		Main contact of active starter

W	=	Westinghouse Relay
GE	=	General Electric Relay
X	=	Square D Type X Relay
KP	=	Square D Type KP Relay
CH	=	Cutler-Hammer Relay

RL-OFF	=	Off-table relay connected to relay
ST-OFF	=	Off-table relay connected to starter

ST-ST-CH	=	Starters state change command
RL-ST-CH	=	Relays state change command

Number of chatter failures per time length

This indicates the number of chatters as a function of the duration of each individual chatter.

The last column shows the total number of chatters and bounces.

Fig. C-1. Legend for chatter detector output and time-history plots.

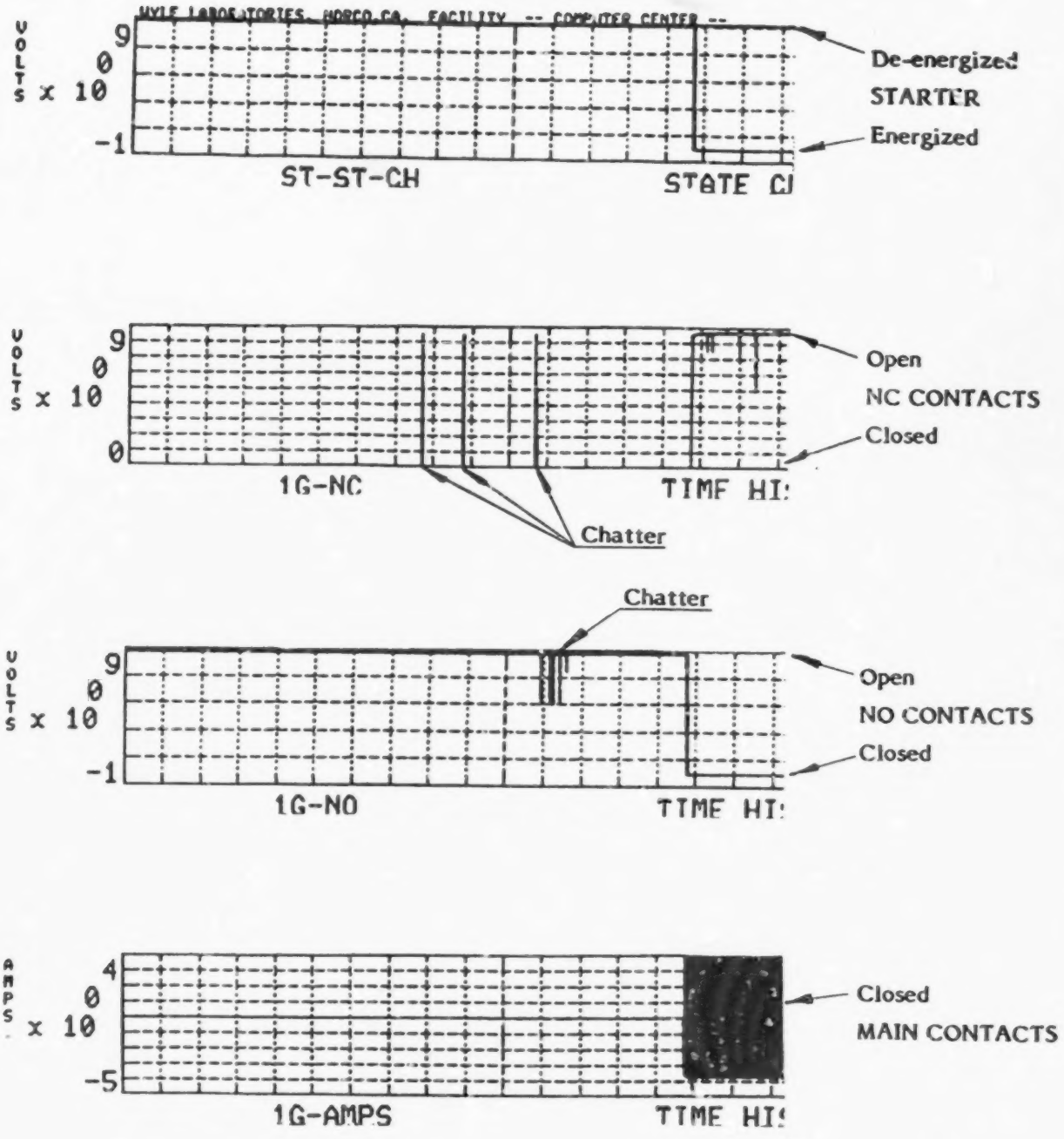

Fig. C-1 (cont.). Legend for chatter detector output and time-history plots.

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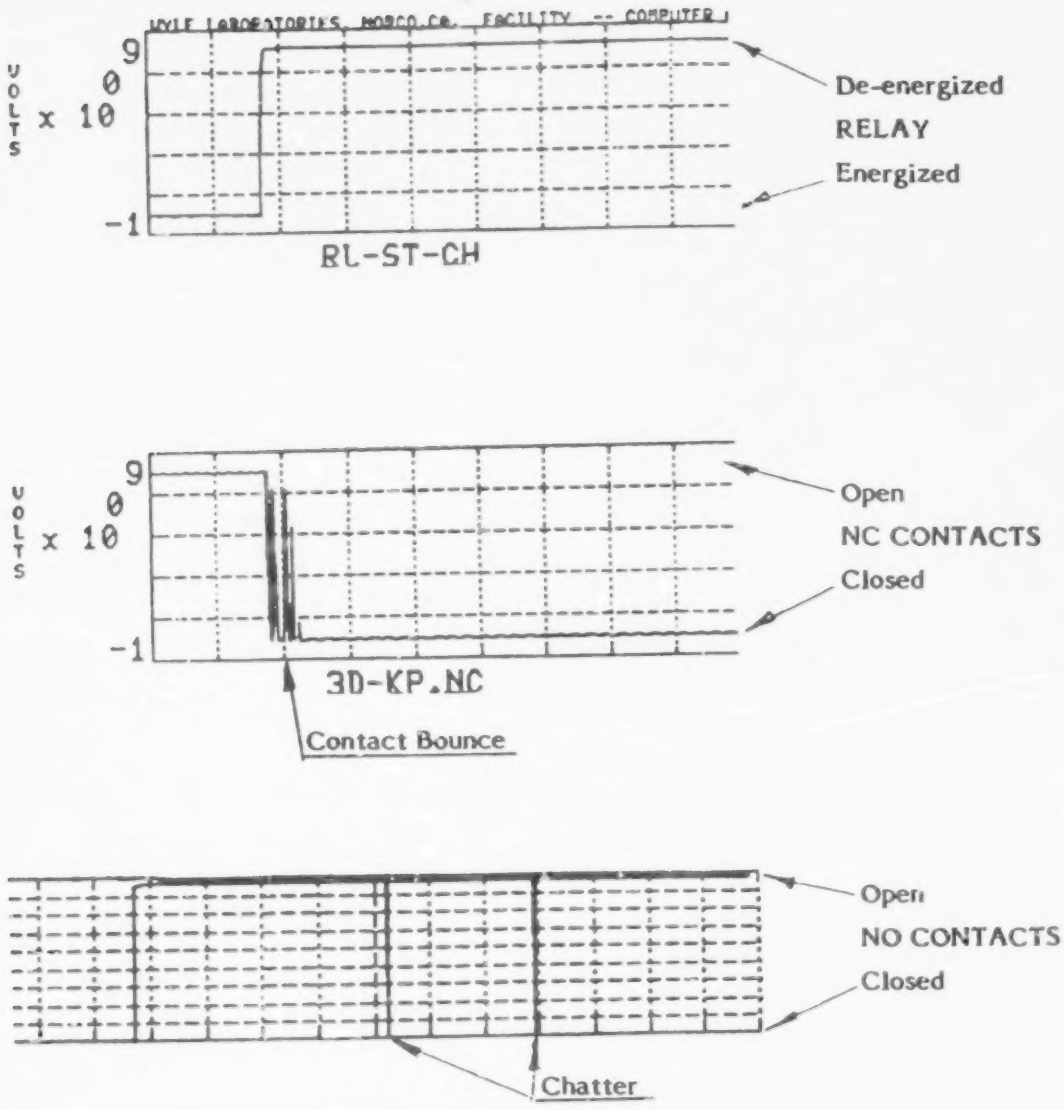


Fig. C-1 (cont.). Legend for chatter detector output and time-history plots.

RUN 17

Four bolts per column with top brace, 2.1g table ZPA

WYLE LABORATORIES,NORCO,CA. FACILITY CHATTER ANALYSIS PROGRAM 10/30/85 13:56:00 HOURS PAGE 1

START TIME= 0.0000 STOP TIME= 25.670

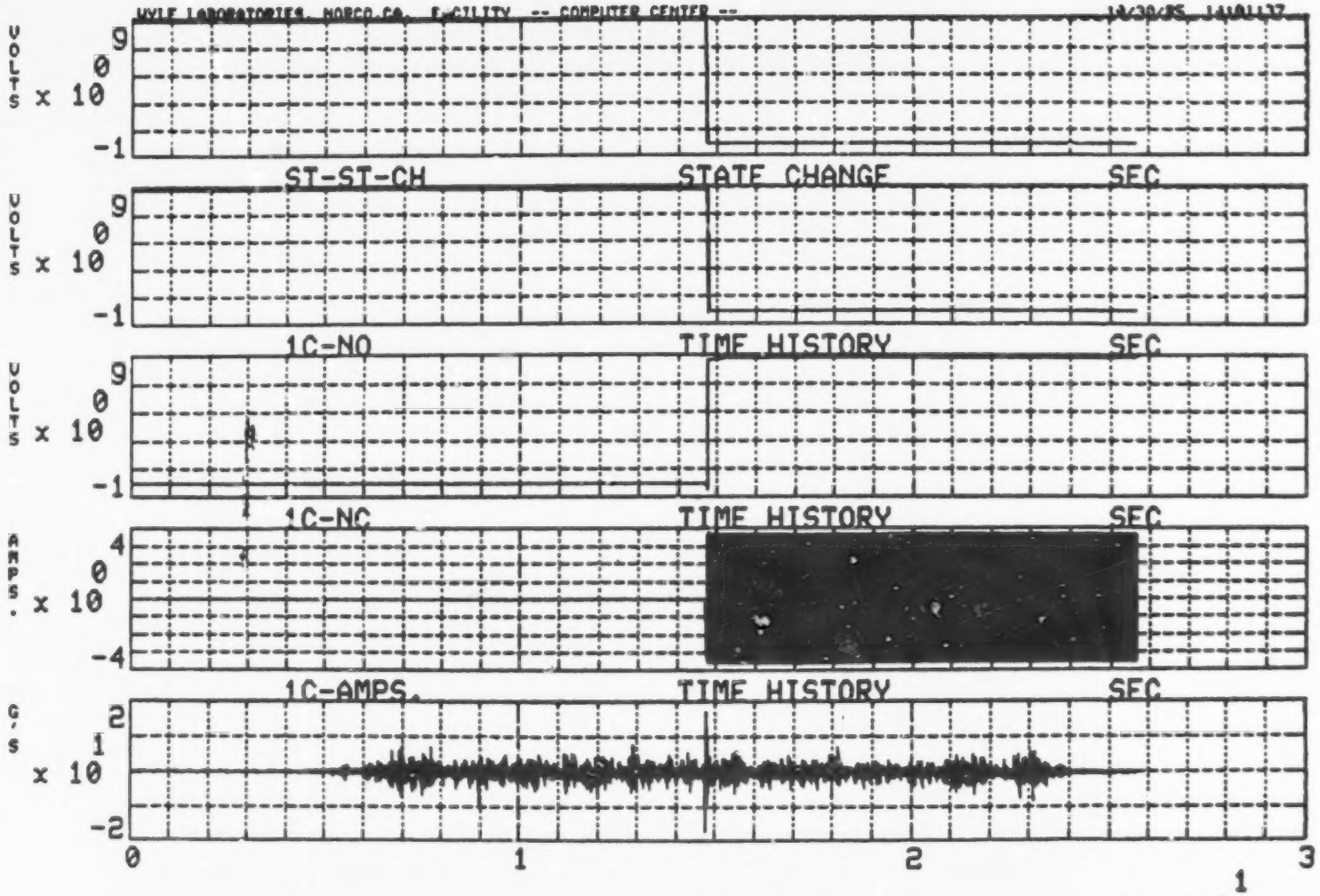
TEST NAME=LLNL 26447, RUN 17, X-Y AXIS, 5TH LEVEL/BOOKEND, OFF-ON FW
TEST DATE=10/03/85 10:16:42 HOURS

CHANNEL ID	CHANNEL NUMBER	FIRST CHATTER	LAST CHATTER	STATE CHANGE	NUMBER OF CHATTER FAILURES PER TIME LENGTH 2.00-5.00	5.00-10.0	10.0-20.0	20.0-40.0	40.0-80.0	>80.0	TOTAL
1C-NO	2			1	NO CHATTER						
1C-NC	3			1	NO CHATTER						
1C-AMPS	4			1	NO CHATTER						
2B-W.NO	6			1	NO CHATTER						
2B-W.NC	7	12.974	12.980	1	0	1	0	0	0	0	1
2B-X.NO	8			1	NO CHATTER						
2B-X.NC	10	7.698	12.985	1	0	2	3	0	0	0	5
1G-NO	11			1	NO CHATTER						
1G-NC	12	7.693	10.687	1	1	0	2	0	0	0	3
1G-AMPS	13			1	NO CHATTER						
1J-W.NO	14			1	NO CHATTER						
1J-W.NC	15			1	NO CHATTER						
1J-KP.NO	16			1	NO CHATTER						
1J-KP.NC	17			1	NO CHATTER						
1M-NO	18			1	NO CHATTER						
1M-NC	19			1	NO CHATTER						
1M-AMPS	20			1	NO CHATTER						
2E-FW.NO	21	6.972	23.124	1	4	0	0	0	1	7	12
2E-FW.NC	22	5.541	23.467	1	4	6	32	8	26	26	102
2E-RV.NO	23			0	NO CHATTER						
2E-RV.NC	24	5.545	23.120	1	2	11	11	2	1	24	51
2E-AMPS	25			0	NO CHATTER						
2J-W.NO	26	7.697	14.396	1	3	3	0	0	0	0	6
2J-W.NC	27	7.698	14.397	1	1	3	0	0	0	0	4
2J-GE.NO	28	9.251	9.256	1	1	0	0	0	0	0	1
2J-GE.NC	29	7.541	14.345	1	3	2	5	0	0	0	10
2J-KP.NO	30			1	NO CHATTER						
2J-KP.NC	31	6.994	14.239	1	2	0	0	0	0	0	2
2J-X.NO	32	6.969	14.384	1	3	11	9	0	0	0	23
2J-X.NC	33	5.538	14.491	1	0	3	26	9	0	0	38
2J-CH.NO	34			1	NO CHATTER						
2J-CH.NC	35			1	NO CHATTER						
2M-NO	36			1	NO CHATTER						
2M-NC	38	7.683	14.379	1	2	0	4	0	0	0	6
2M-AMPS	39			1	NO CHATTER						
3B-NO	40	14.756	14.761	1	1	0	0	0	0	0	1
3B-NC	42	7.504	14.405	1	3	3	4	1	0	0	11
3B-AMPS	43	18.328	18.345	1	0	0	1	0	0	0	1
3D-GE.NO	44			1	NO CHATTER						

WYLE LABORATORIES,NORCO,CA. FACILITY CHATTER ANALYSIS PROGRAM 10/30/85 13:56:00 HOURS PAGE 2

TEST NAME=LLNL 26447, RUN 17, X-Y AXIS, 5TH LEVEL/BOOKEND, OFF-ON FW
TEST DATE=10/03/85 10:16:42 HOURS

CHANNEL ID	CHANNEL NUMBER	FIRST CHATTER	LAST CHATTER	STATE CHANGE	NUMBER OF CHATTER FAILURES PER TIME LENGTH 2.00-5.00	5.00-10.0	10.0-20.0	20.0-40.0	40.0-80.0	>80.0	TOTAL
3D-GE.NC	45	7.738	13.034	1	0	1	2	0	0	0	3
3D-CH.NO	46			1	NO CHATTER						
3D-CH.NC	47			1	NO CHATTER						
3D-KP.NO	48			1	NO CHATTER						
3D-KP.NC	49			1	NO CHATTER						
3G-NO	50	7.699	12.992	1	0	3	1	0	0	0	4
3G-NC	51	6.975	14.406	1	2	1	5	3	0	0	11
3G-AMPS	52	7.702	13.028	1	0	0	0	0	2	0	2
3J-GE1NO	53			1	NO CHATTER						
3J-GE1NC	54	7.741	12.182	1	0	0	2	1	0	0	3
3J-GE2NO	55			1	NO CHATTER						
3J-GE2NC	56	7.740	12.178	1	0	0	2	1	0	0	3
3M-FW.NO	57			1	NO CHATTER						
3M-FW.NC	58	6.889	14.387	1	4	11	3	0	0	0	18
3M-RV.NO	59			0	NO CHATTER						
3M-RV.NC	60	6.973	14.394	0	5	7	2	0	0	0	14
3M-AMPS	61			1	NO CHATTER						
ST-ST-CH	62				STATE SW. # 2		CHANGE AT 14.726				
RL-ST-CH	63				STATE SW. # 1		CHANGE AT 14.752				
										TOTAL=	335



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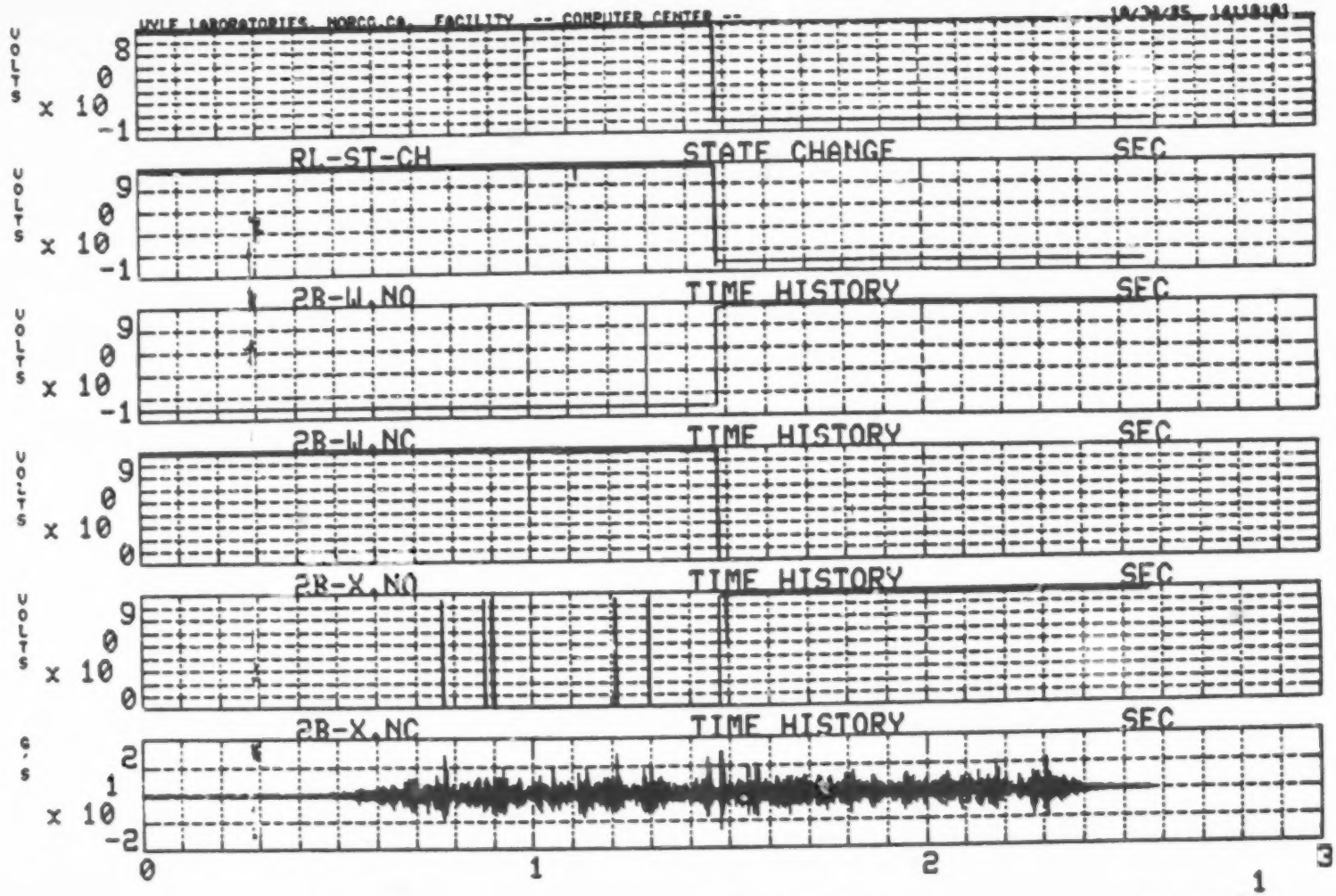


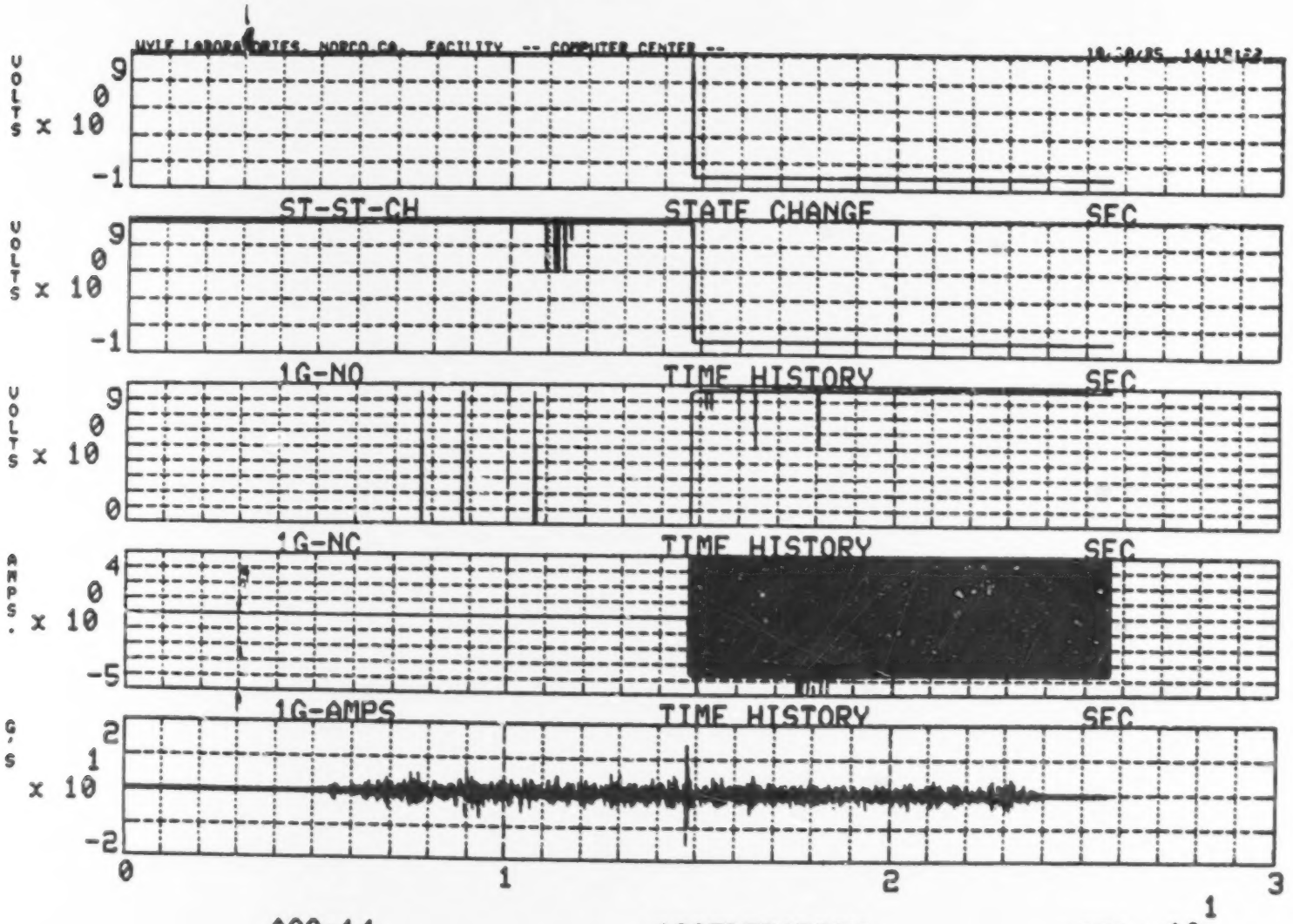
ACC-10 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 10/03/85 DISPLAY NUMBER 2 .00 TO 25.67 SEC

LLNL 26447, RUN 17, X-Y AXIS, 5TH LEVEL/BOOKEND, OFF-ON FW

BEST COPY AVAILABLE



ACC-14 ACCELERATION SEC x10

NO FILTER, 1000.00 SPS,

DATE 10/03/85 DISPLAY NUMBER 3 .00 TO 25.67 SEC

LLNL 26447, RUN 17, X-Y AXIS, 5TH LEVEL/BOOKEND, OFF-ON FW

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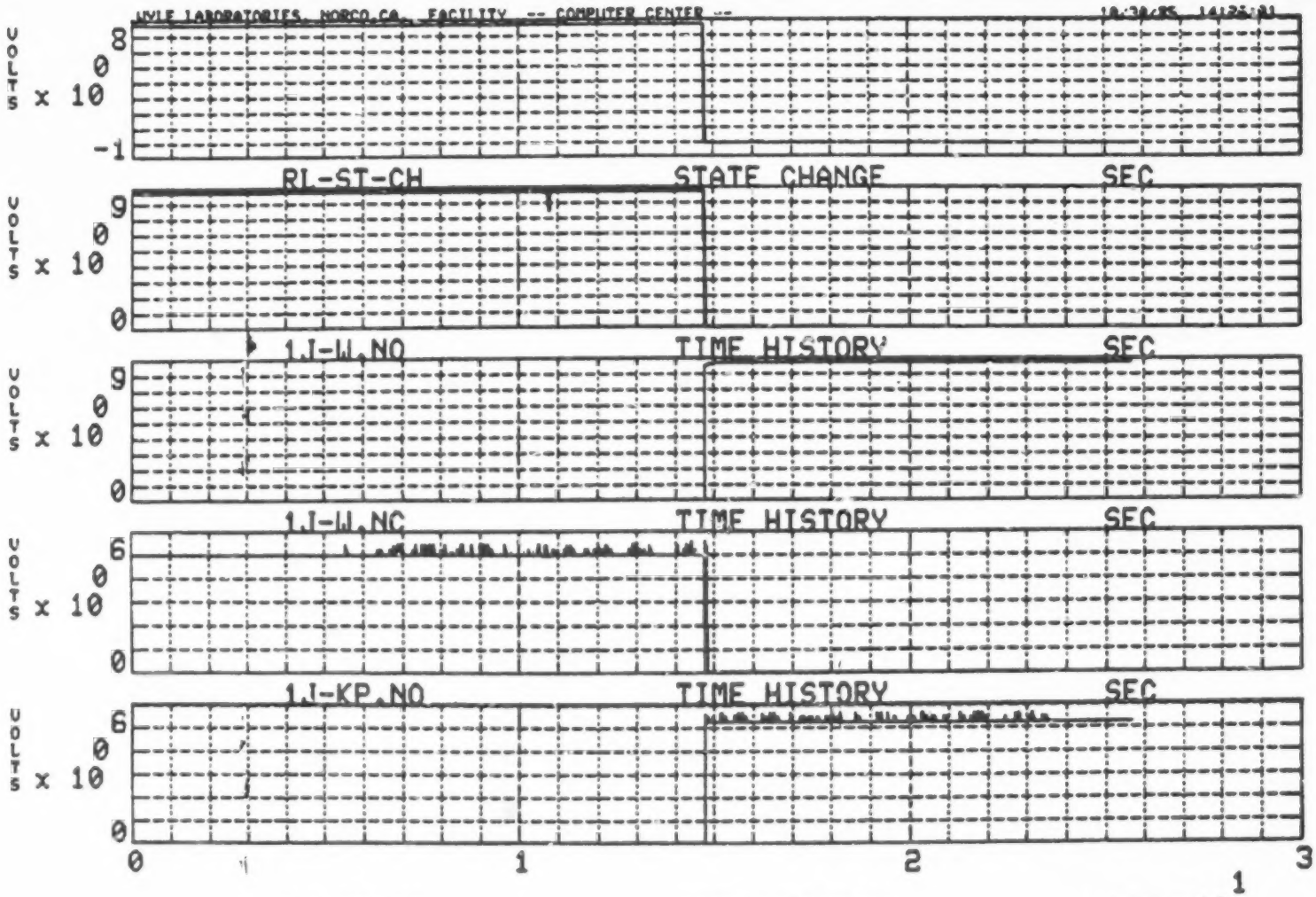

1J-KP.NC TIME HISTORY SEC x 10^{1}

NO FILTER, 1000.00 SPS,

DATE 10/03/85 DISPLAY NUMBER 4 .00 TO 25.67 SEC

LLNL 26447, RUN 17, X-Y AXIS, 5TH LEVEL/BOOKEND, OFF-ON FW

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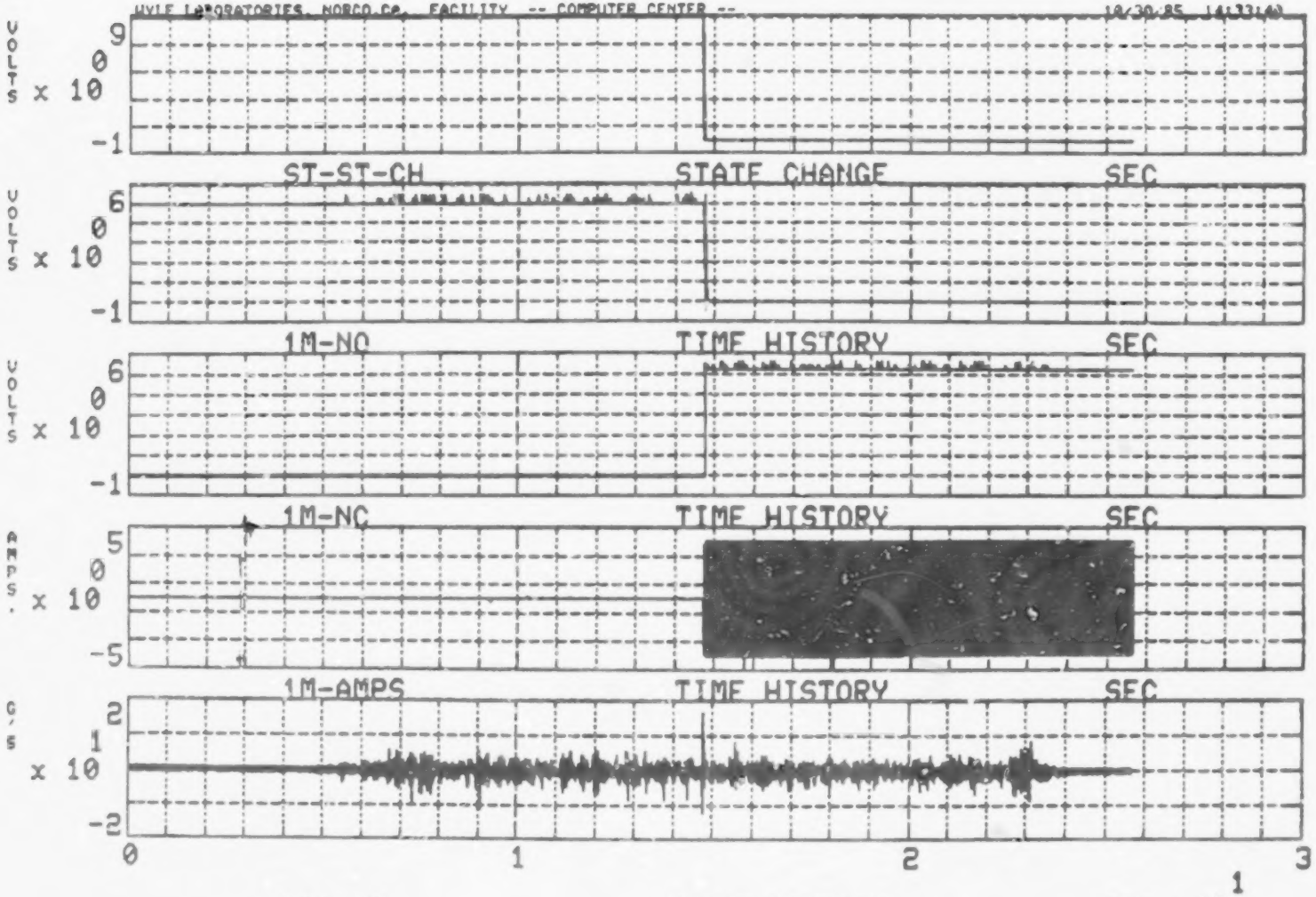


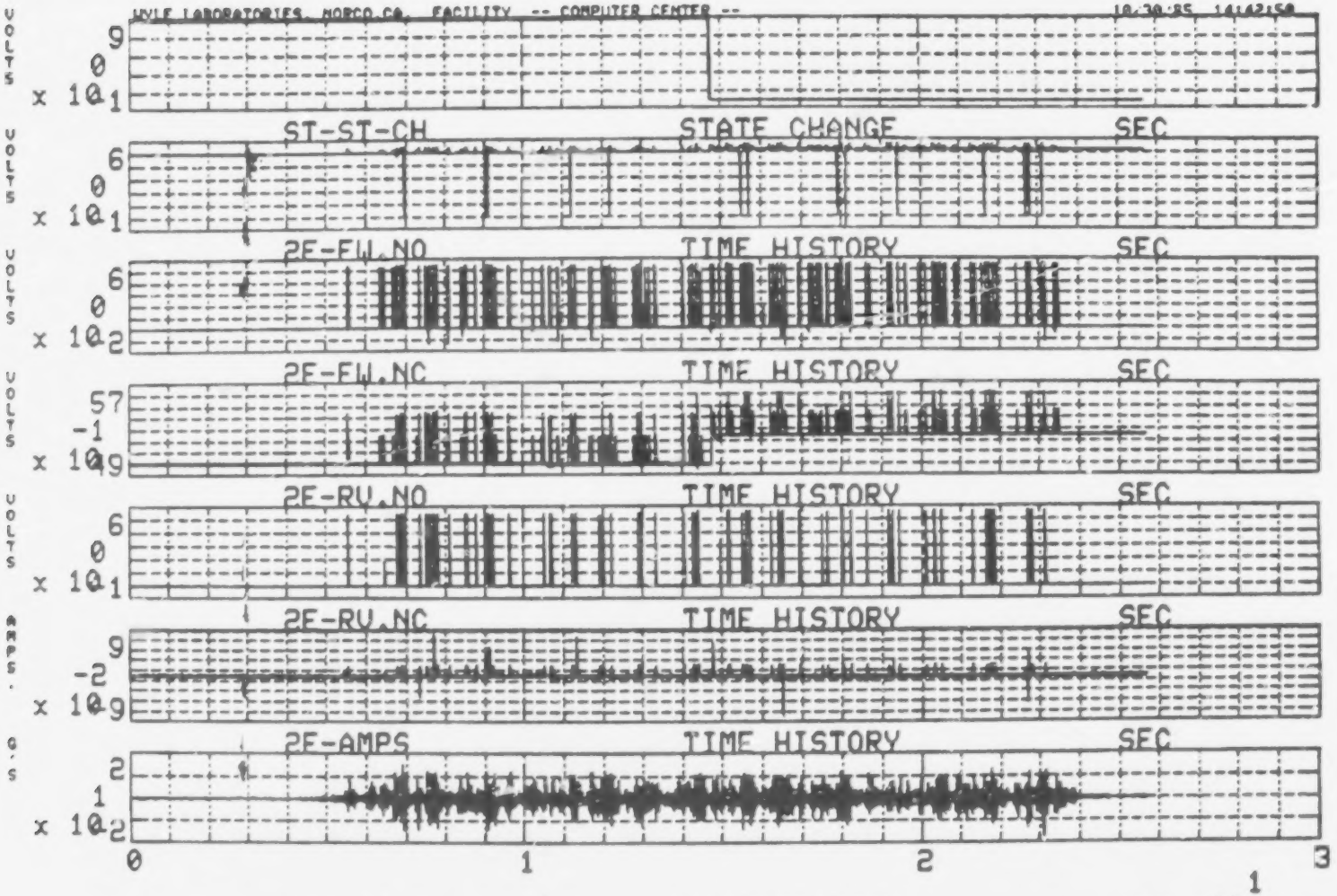
ACC-18 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 10/03/85 DISPLAY NUMBER 5 .00 TO 25.67 SEC

LLNL 26447, RUN 17, X-Y AXIS, 5TH LEVEL/BOOKEND, OFF-ON FW

BEST COPY AVAILABLE



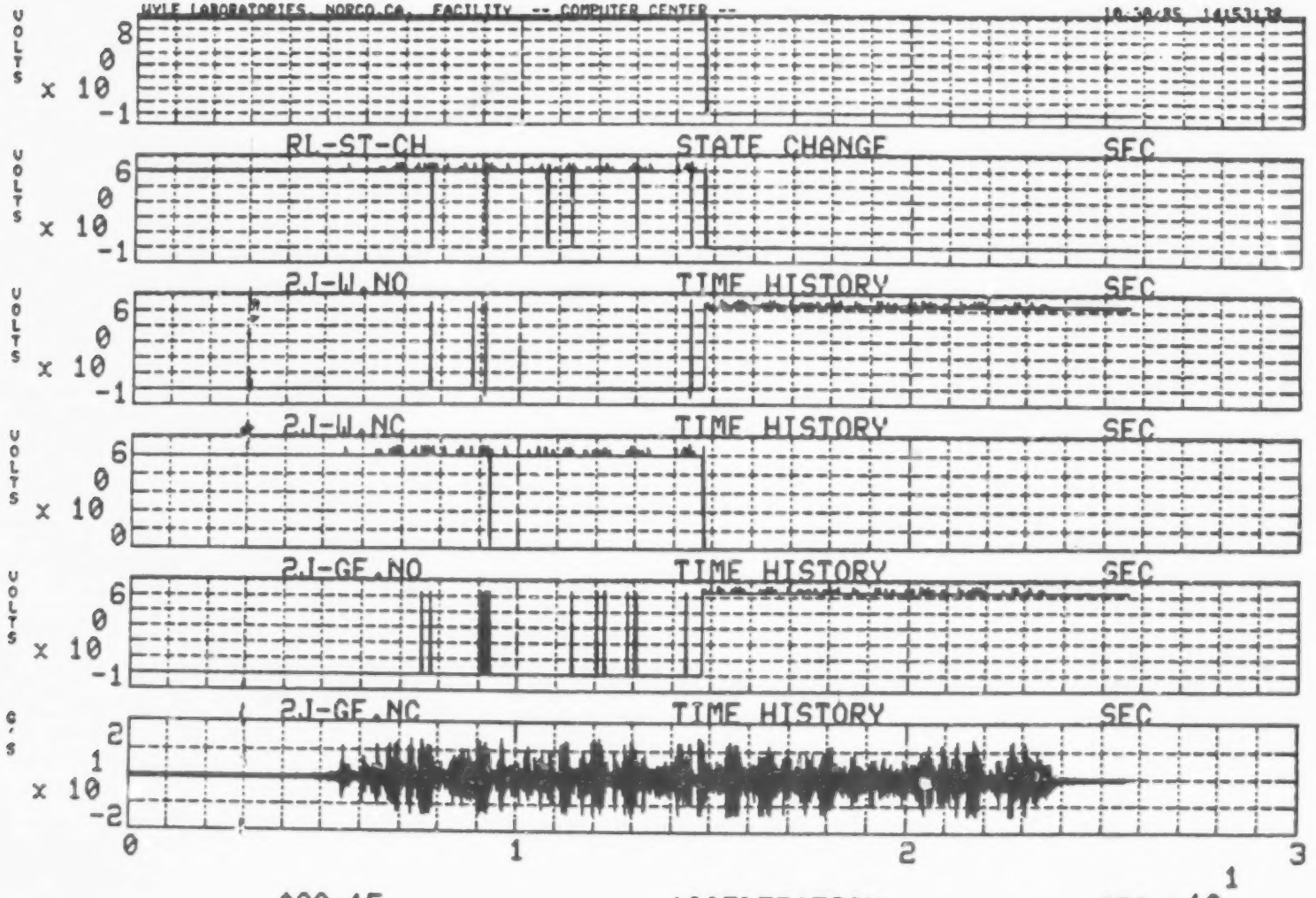
ACC-11 ACCELERATION SEC x 10^{1}

NO FILTER, 1000.00 SPS,

DATE 10/03/85 DISPLAY NUMBER 6 .00 TO 25.67 SEC

LLNL 26447, RUN 17, X-Y AXIS. 5TH LEVEL/BOOKEND, OFF-ON FW

BEST COPY AVAILABLE



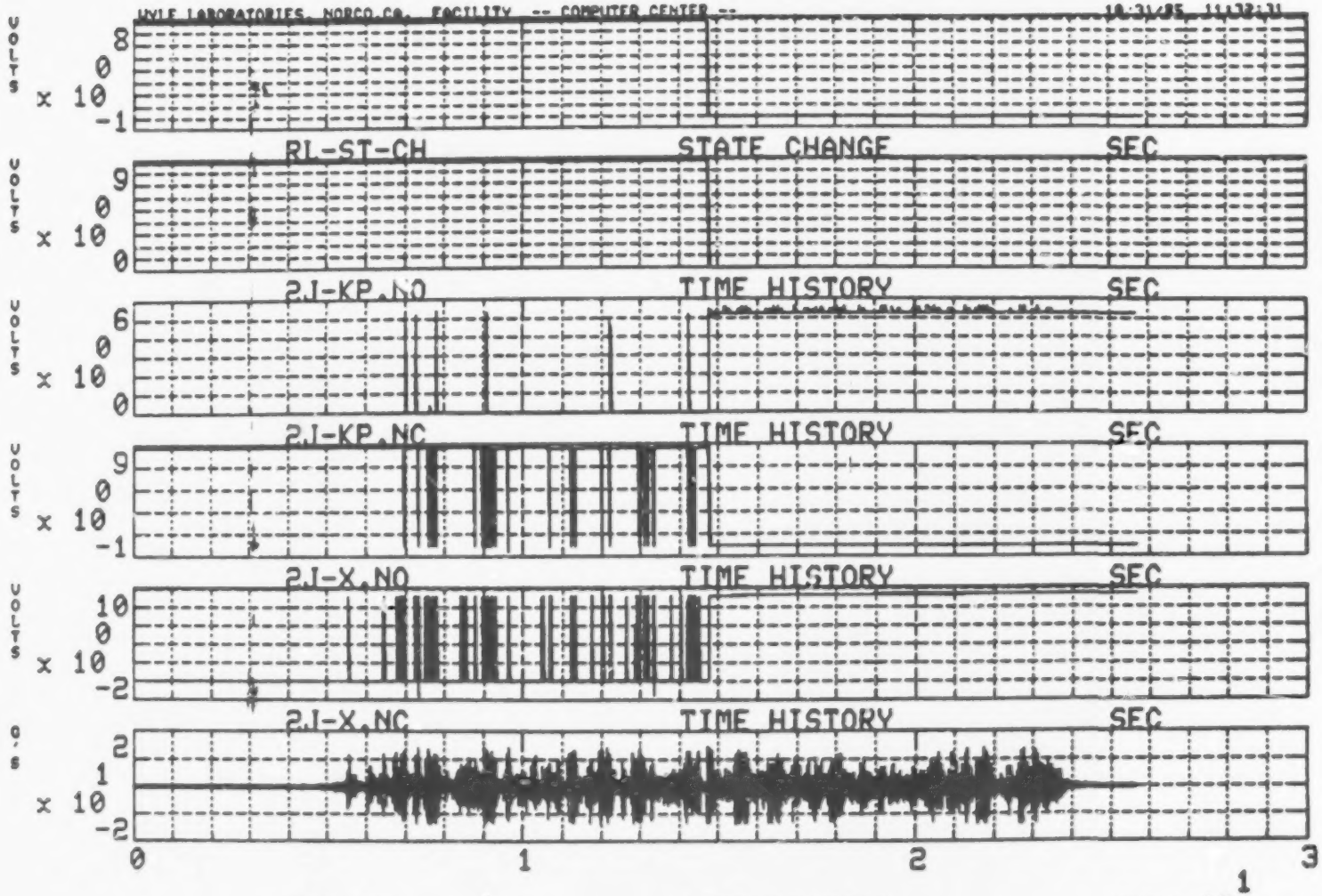
ACC-15 ACCELERATION SEC x10

NO FILTER, 1000.00 SPS,

DATE 10/03/85 DISPLAY NUMBER 7 .00 TO 25.67 SEC

LLNL 26447, RUN 17, X-Y AXIS, 5TH LEVEL/BOOKEND, OFF-ON FW

BEST COPY AVAILABLE



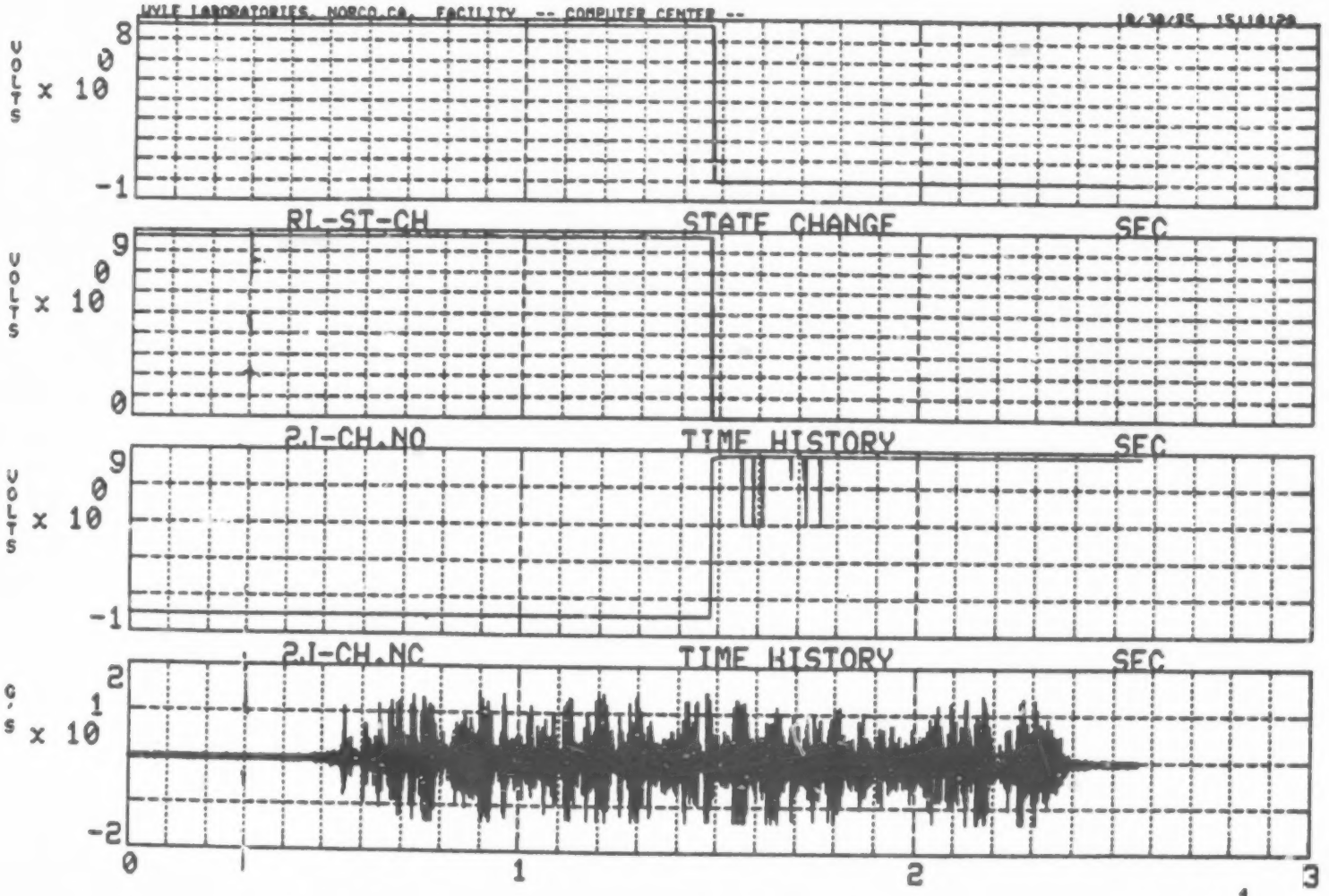
ACC-15 ACCELERATION SEC x 10^{1}

NO FILTER, 1000.00 SPS,

DATE 10/03/85 DISPLAY NUMBER 8 .00 TO 25.67 SEC

LLNL 26447, RUN 17, X-Y AXIS, 5TH LEVEL/BOOKEND, OFF-ON FW,

BEST COPY AVAILABLE



ACC-15 ACCELERATION SEC x10

NO FILTER, 1000.00 SPS,

DATE 10/03/85 DISPLAY NUMBER 9 .00 TO 25.67 SEC

LLNL 26447, RUN 17, X-Y AXIS, 5TH LEVEL/BOOKEND, OFF-ON FW

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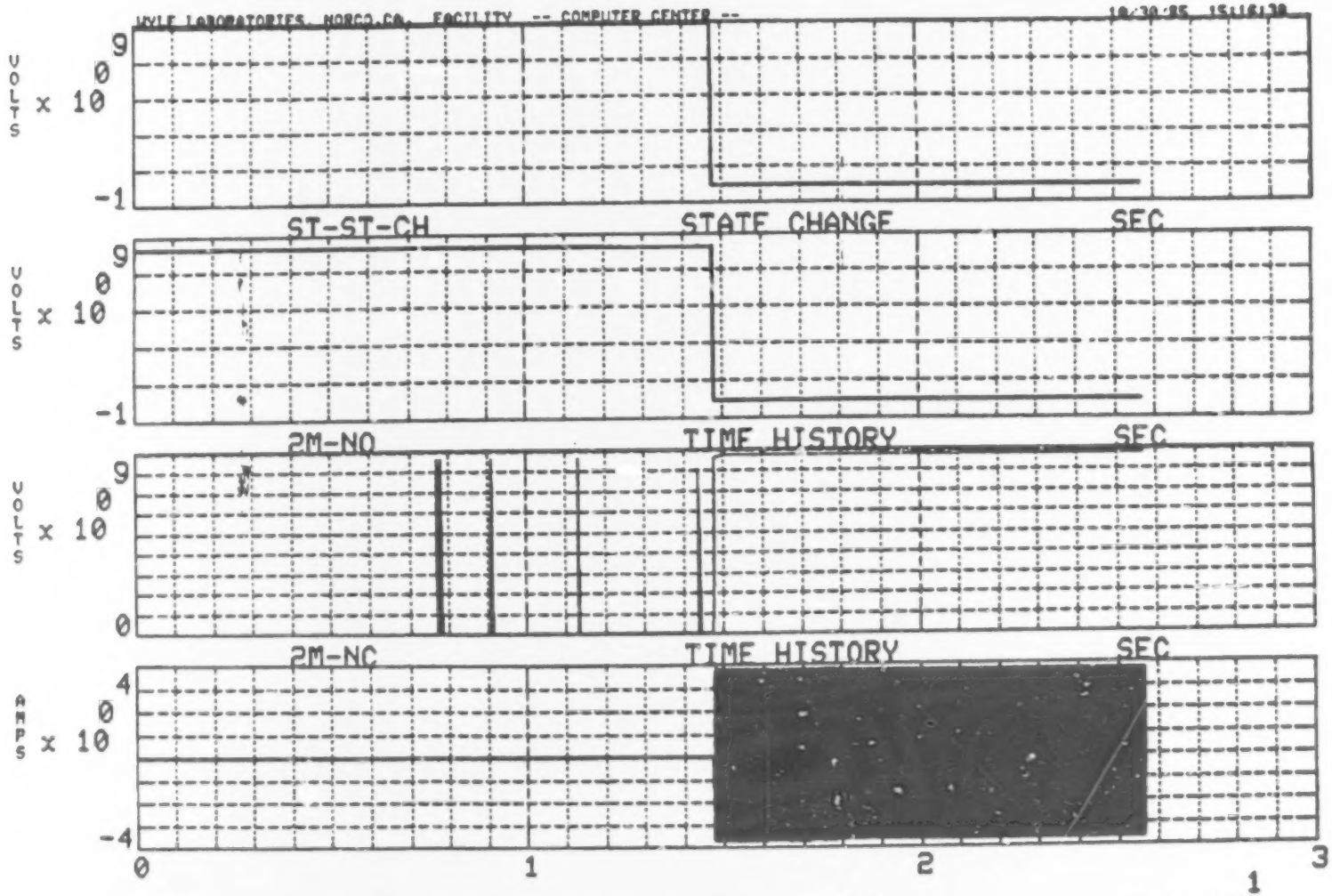


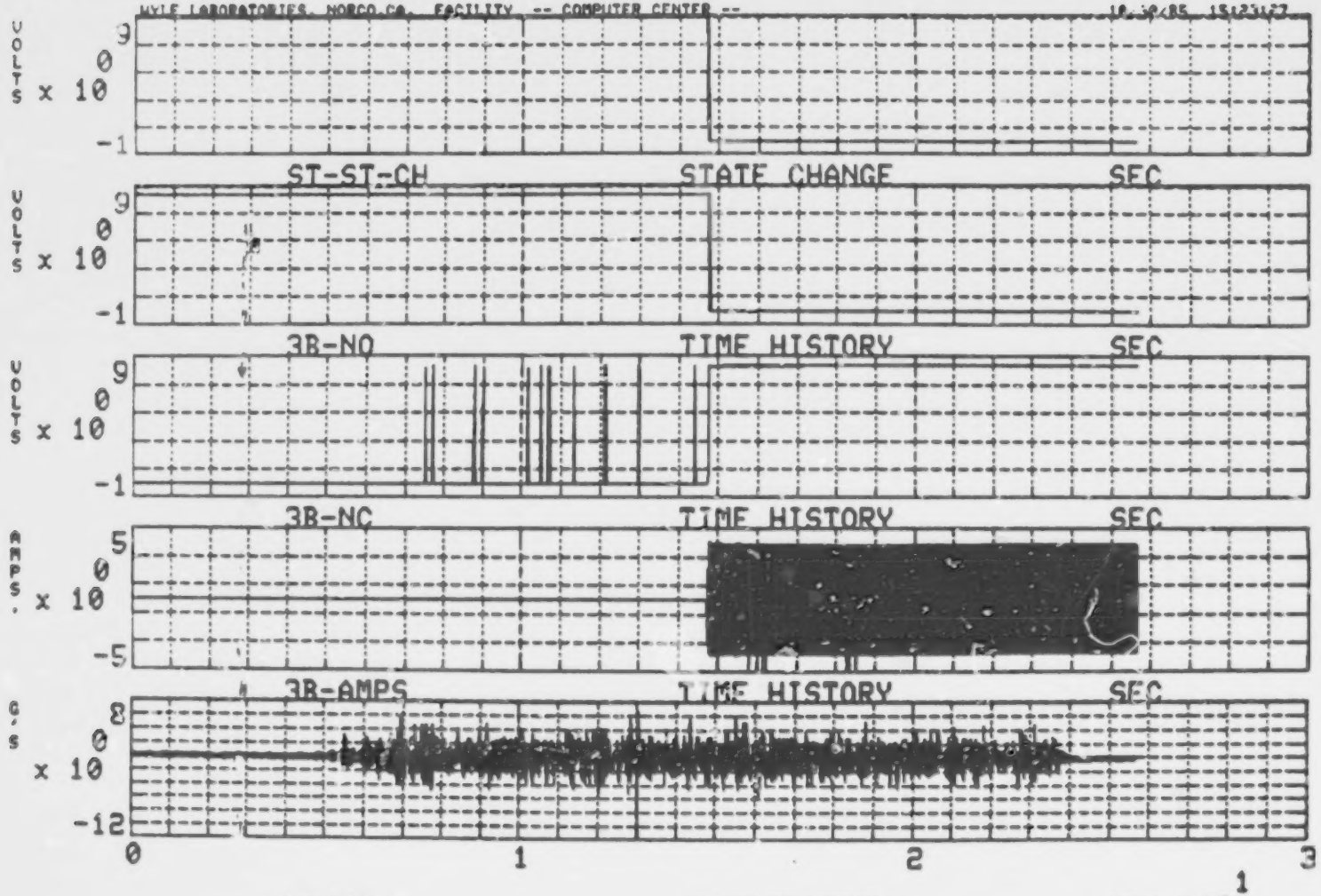
2M-AMPS TIME HISTORY

NO FILTER, 1000.00 SPS,

DATE 10/03/85 DISPLAY NUMBER 10 .00 TO 25.67 SEC

LLNL 26447, RUN 17, X-Y AXIS, 5TH LEVEL/BOOKEND, OFF-ON FW

BEST COPY AVAILABLE



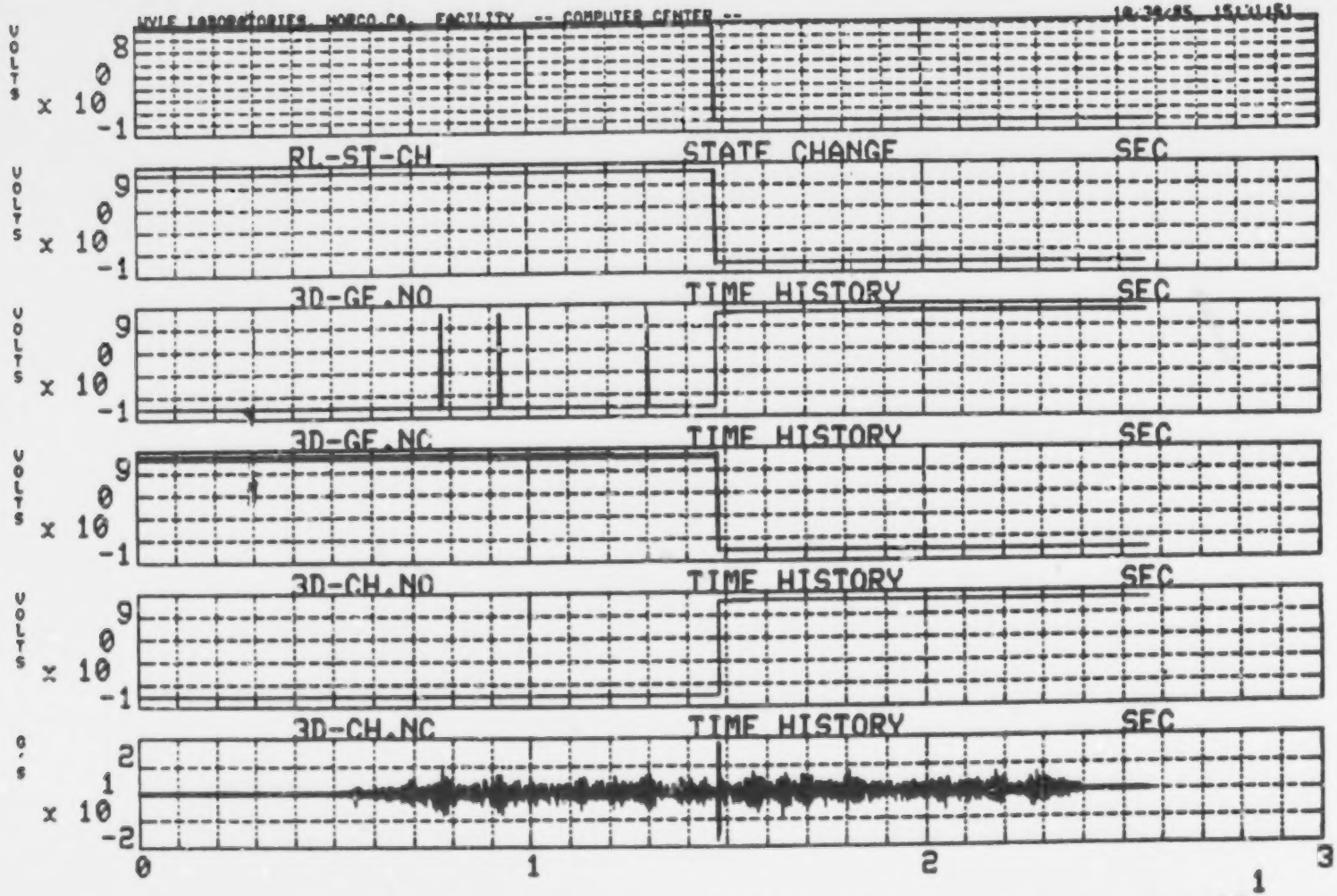
ACC-9 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 10/03/85 DISPLAY NUMBER 11 .00 TO 25.67 SEC

LLNL 26447, RUN 17, X-Y AXIS, 5TH LEVEL/BOOKEND, OFF-ON FW

BEST COPY AVAILABLE



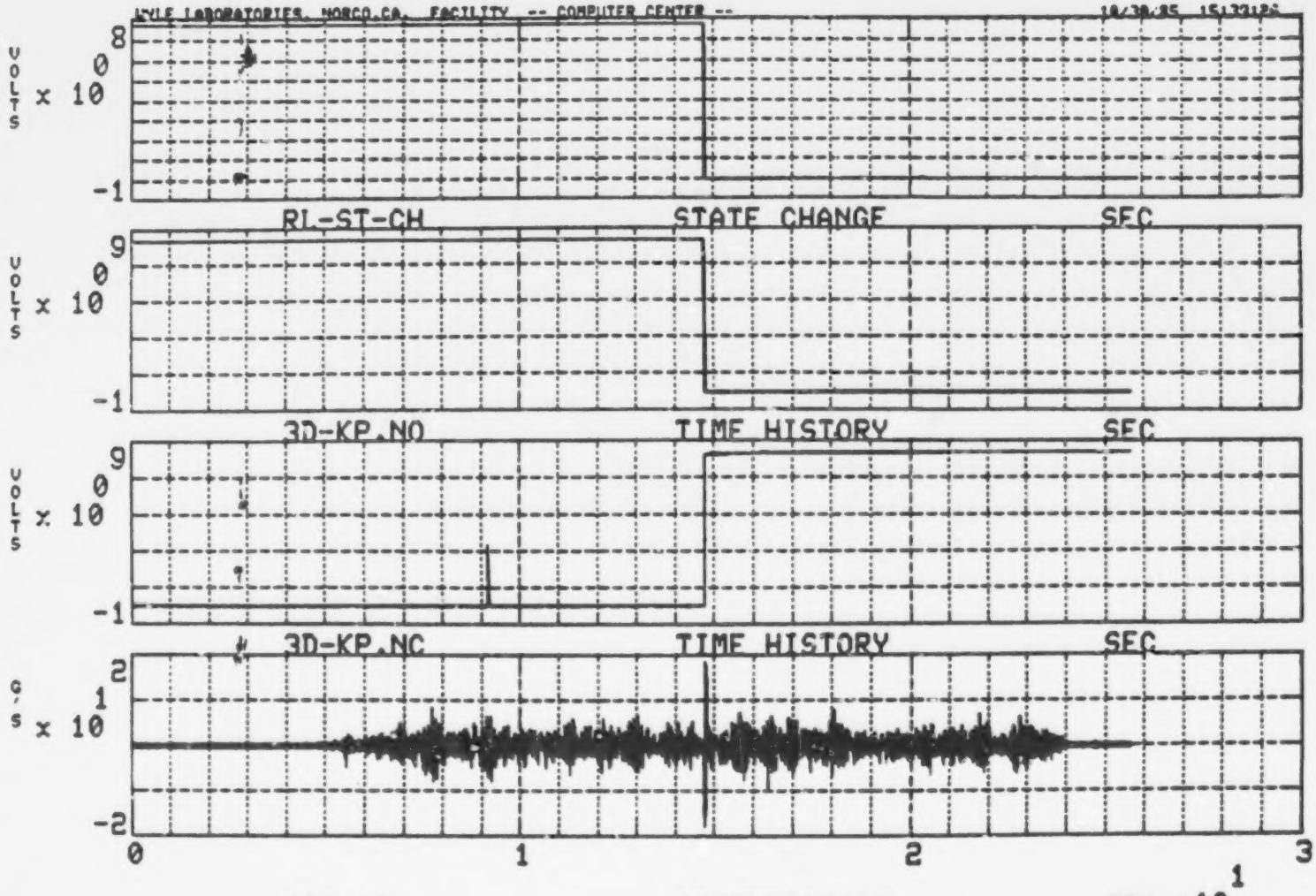
ACC-13 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 10/03/85 DISPLAY NUMBER 12 .00 TO 25.67 SEC

LLNL 26447, RUN 17, X-Y AXIS, 5TH LEVEL/BOOKEND, OFF-ON FW

BEST COPY AVAILABLE



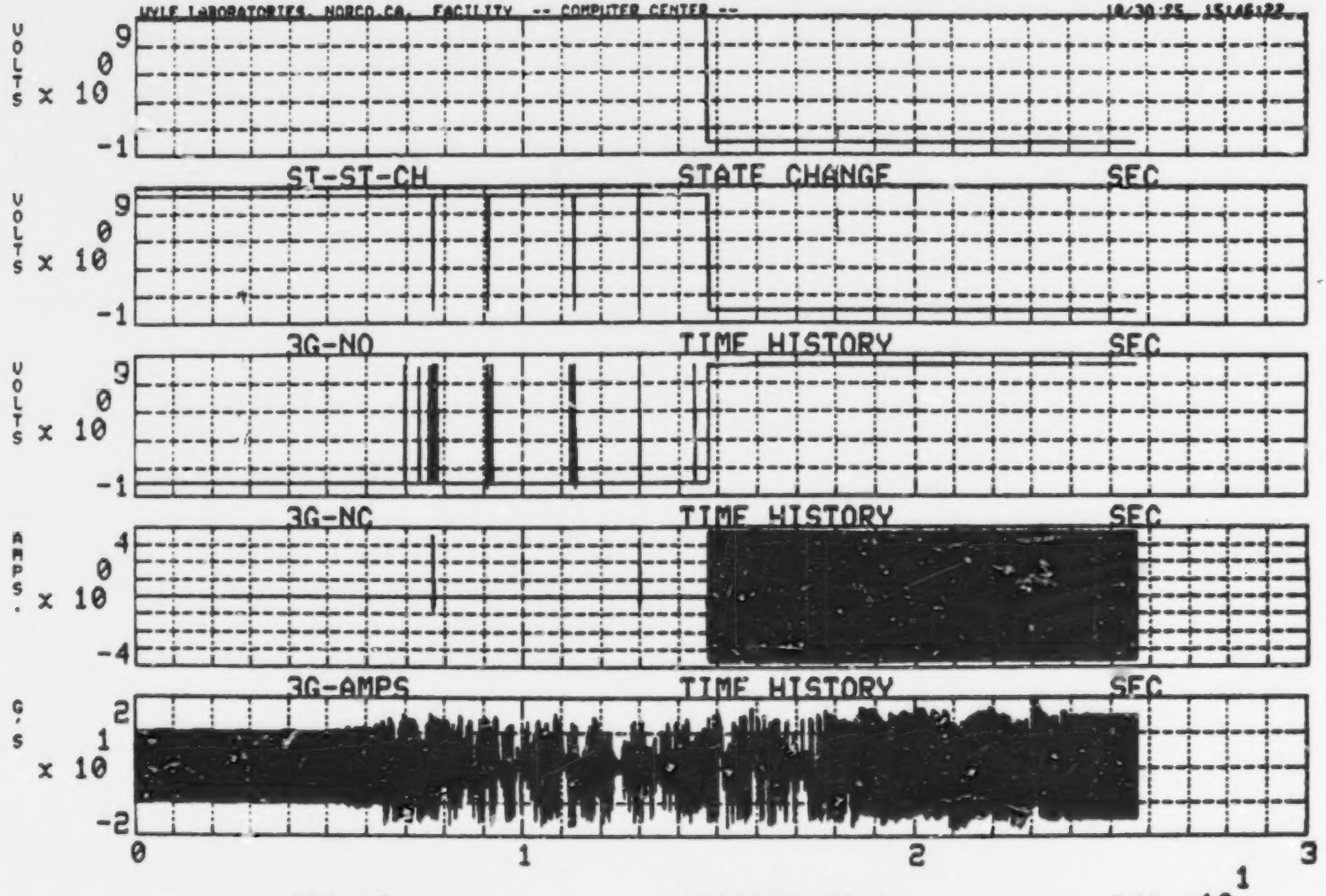
ACC-13 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 10/03/85 DISPLAY NUMBER 13 .00 TO 25.67 SEC

LLNL 26447, RUN 17, X-Y AXIS, 5TH LEVEL/BOOKEND, OFF-ON FW

BEST COPY AVAILABLE



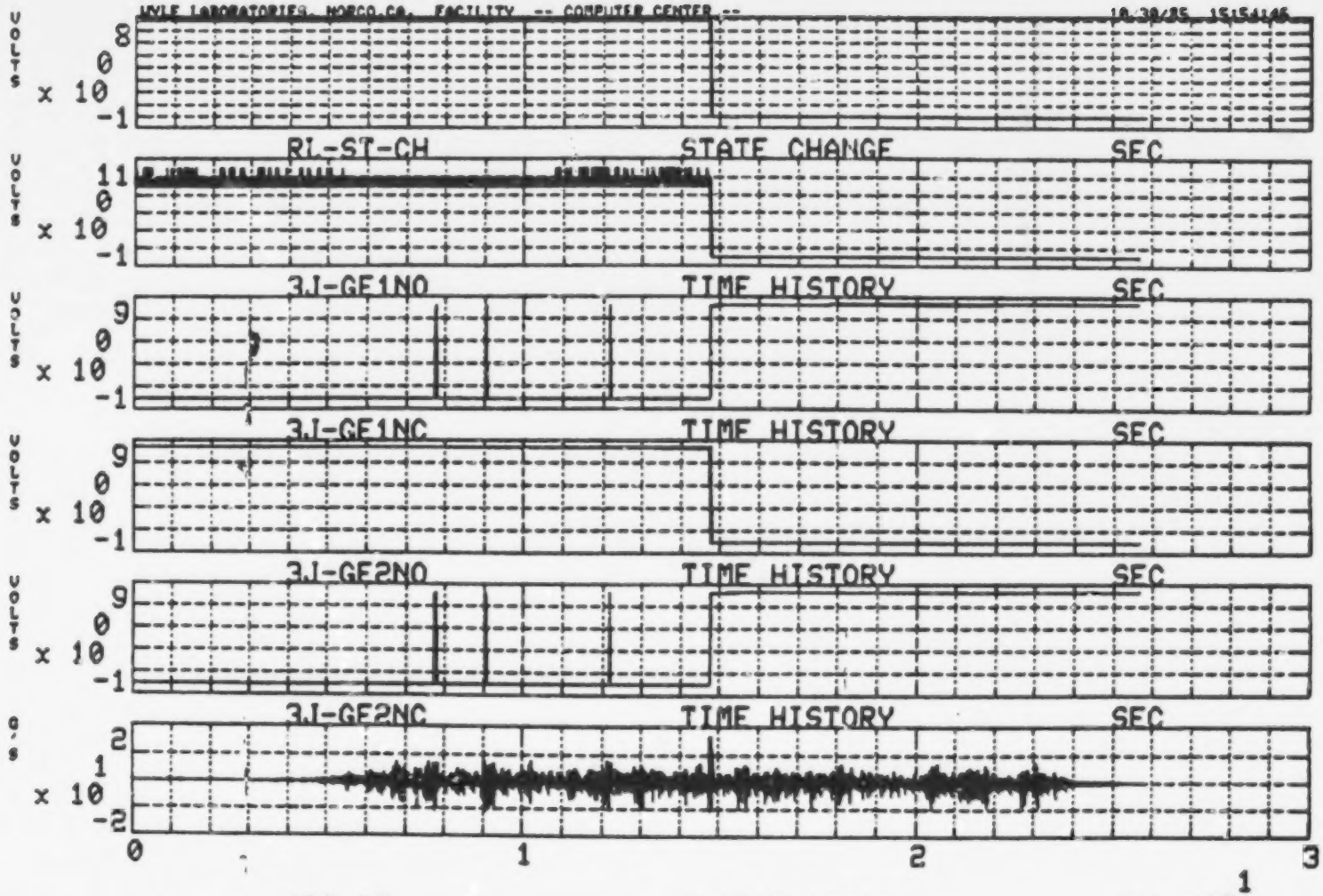
ACC-16 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 10/03/85 DISPLAY NUMBER 14 .00 TO 25.67 SEC

LLNL 26447, RUN 17, X-Y AXIS, 5TH LEVEL/BOOKEND, OFF-ON FW

BEST COPY AVAILABLE



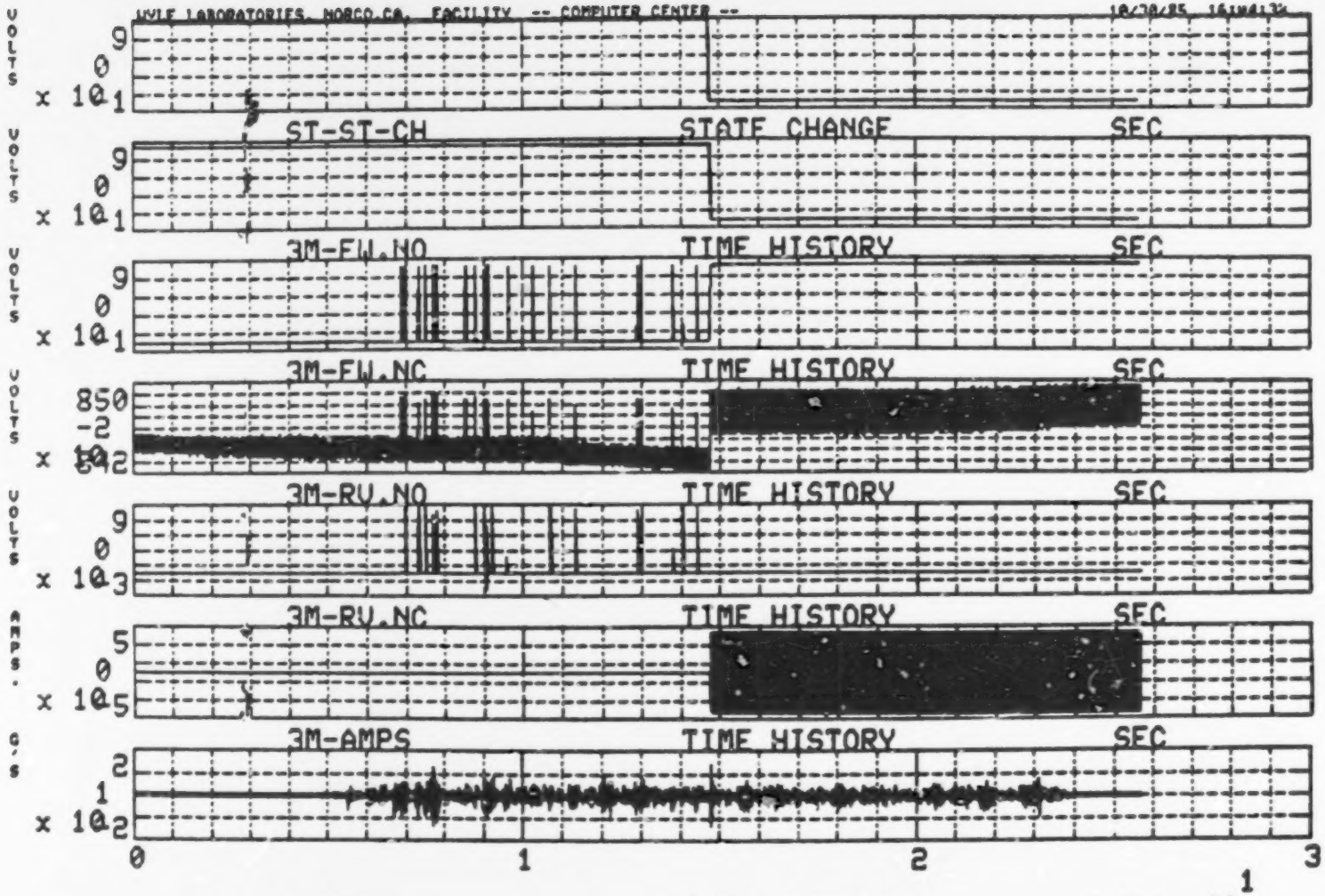
ACC-17 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 10/03/85 DISPLAY NUMBER 15 .00 TO 25.67 SEC

LLNL 26447, RUN 17, X-Y AXIS, 5TH LEVEL/BOOKEND, OFF-ON FW

BEST COPY AVAILABLE



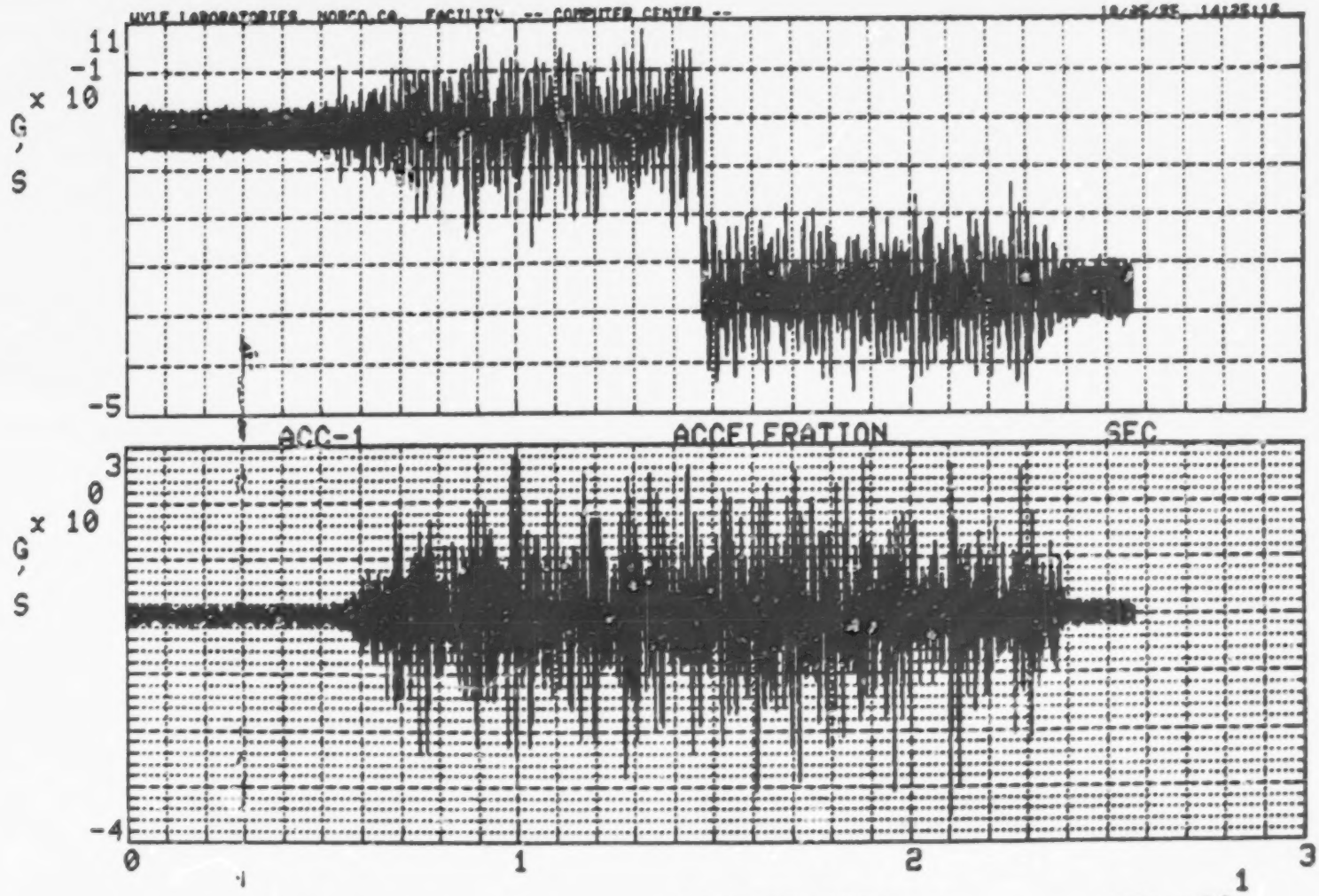
ACC-19 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 10/03/85 DISPLAY NUMBER 16 .00 TO 25.67 SEC

LLNL 26447, RUN 17, X-Y AXIS, 5TH LEVEL/BOOKEND, OFF-ON FW

BEST COPY AVAILABLE



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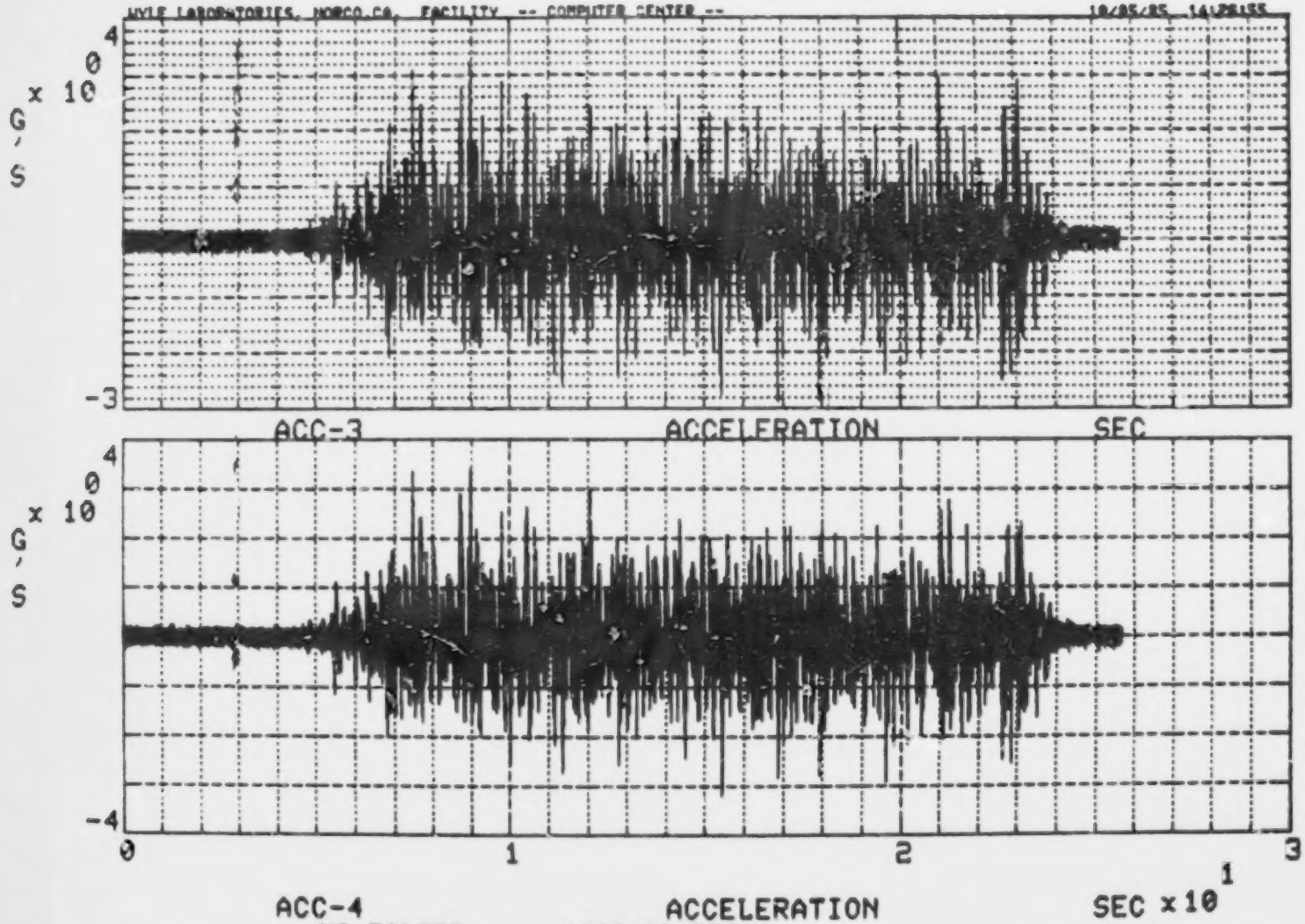

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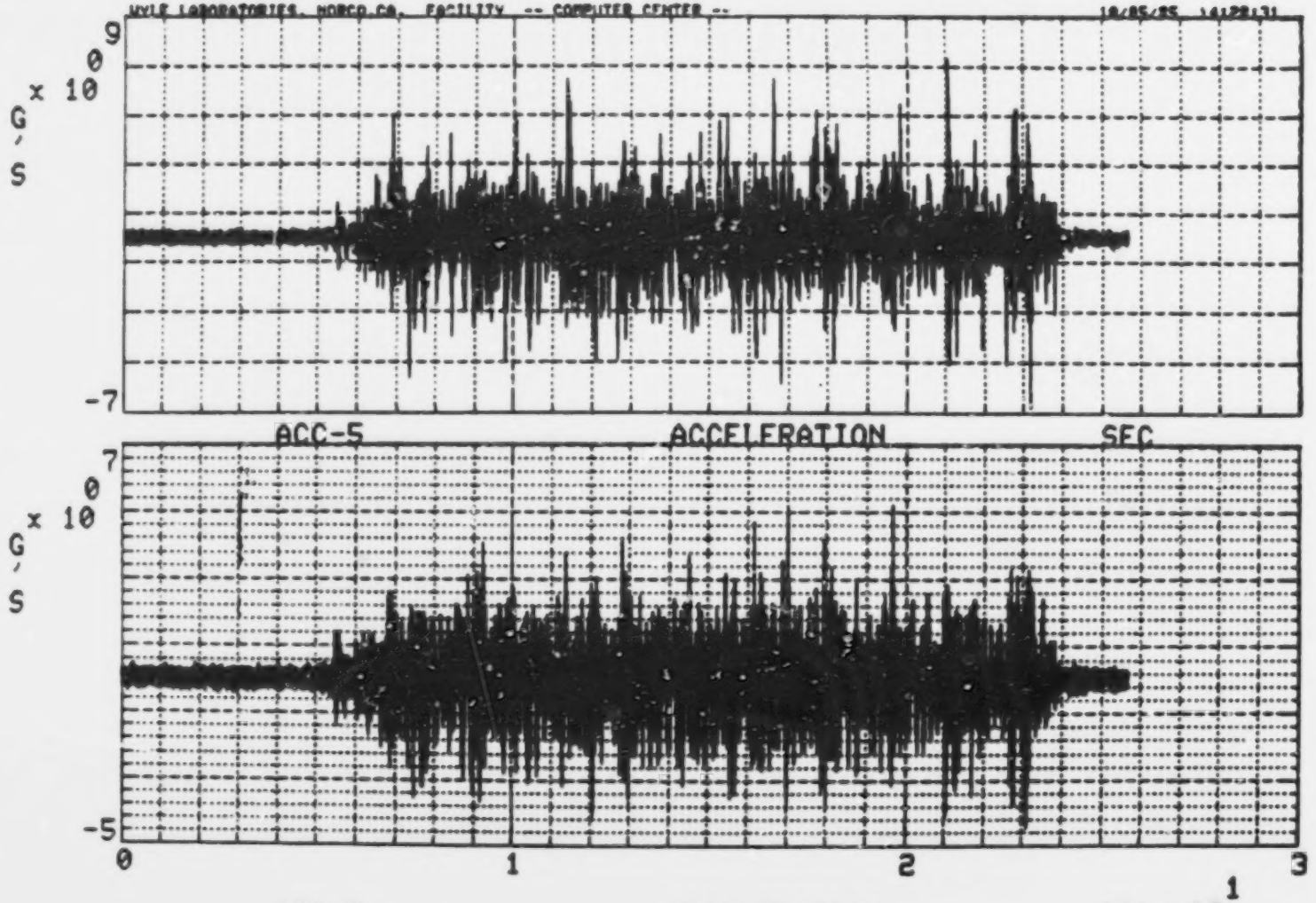

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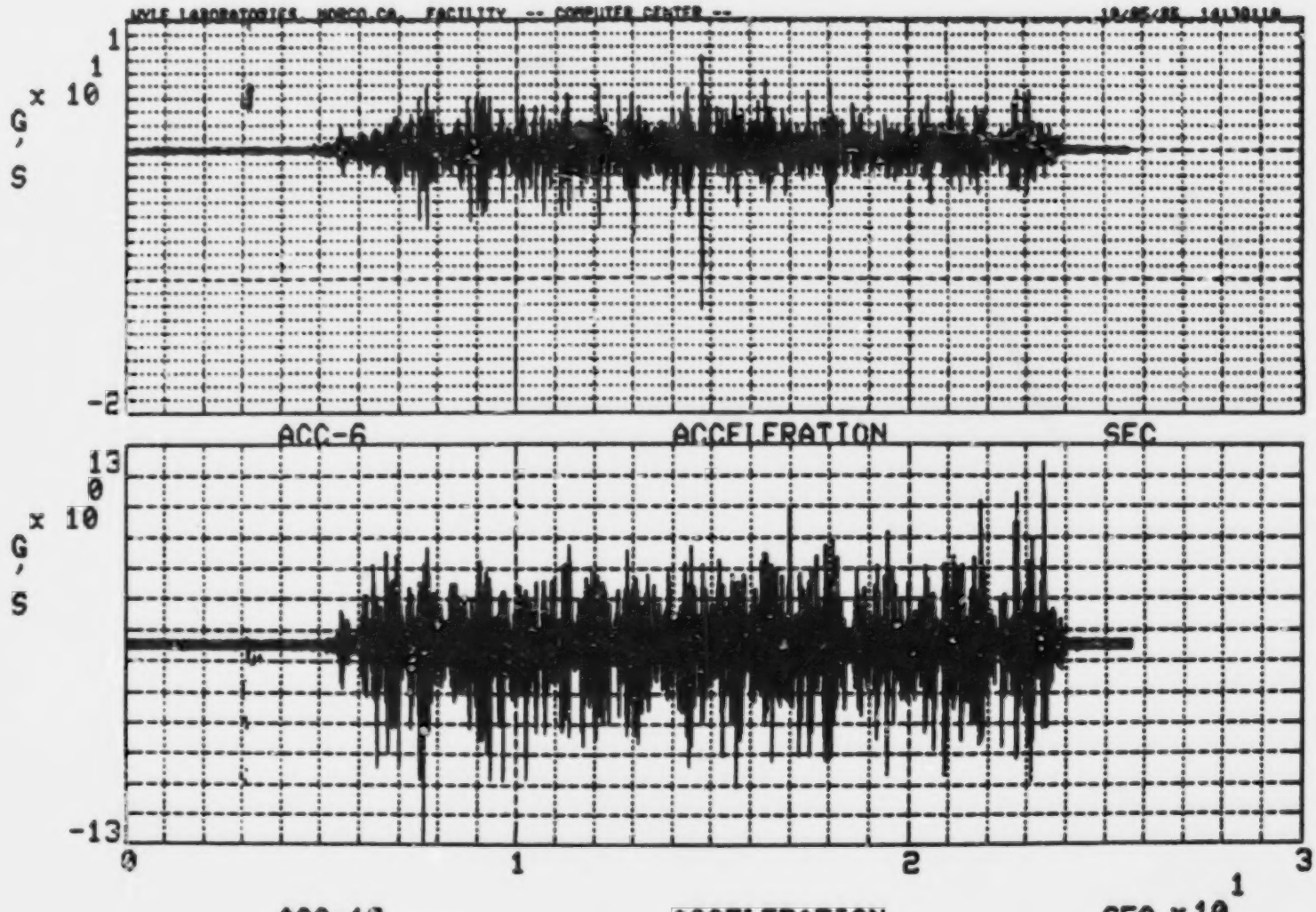


ACC-12 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 10/03/85 DISPLAY NUMBER 20 .00 TO 25.67 SEC

LLNL 26447, RUN 17, X-Y AXIS, 5TH LEVEL/BOOKEND, OFF-ON FW

BEST COPY AVAILABLE

R U N 3 1

Four bolts per column with no top brace, 2.2g table ZPA

WYLE LABORATORIES,NORCO,CA. FACILITY CHATTER ANALYSIS PROGRAM 11/04/85 11:45:10 HOURS PAGE 1

START TIME= 0.0000 STOP TIME= 26.860

TEST NAME=LLNL 26447, RUN 31, X-Y AXIS, 4TH LEVEL/12 BOLTS, ON-OFF RV,
TEST DATE=10/25/85 15:23: 3 HOURS

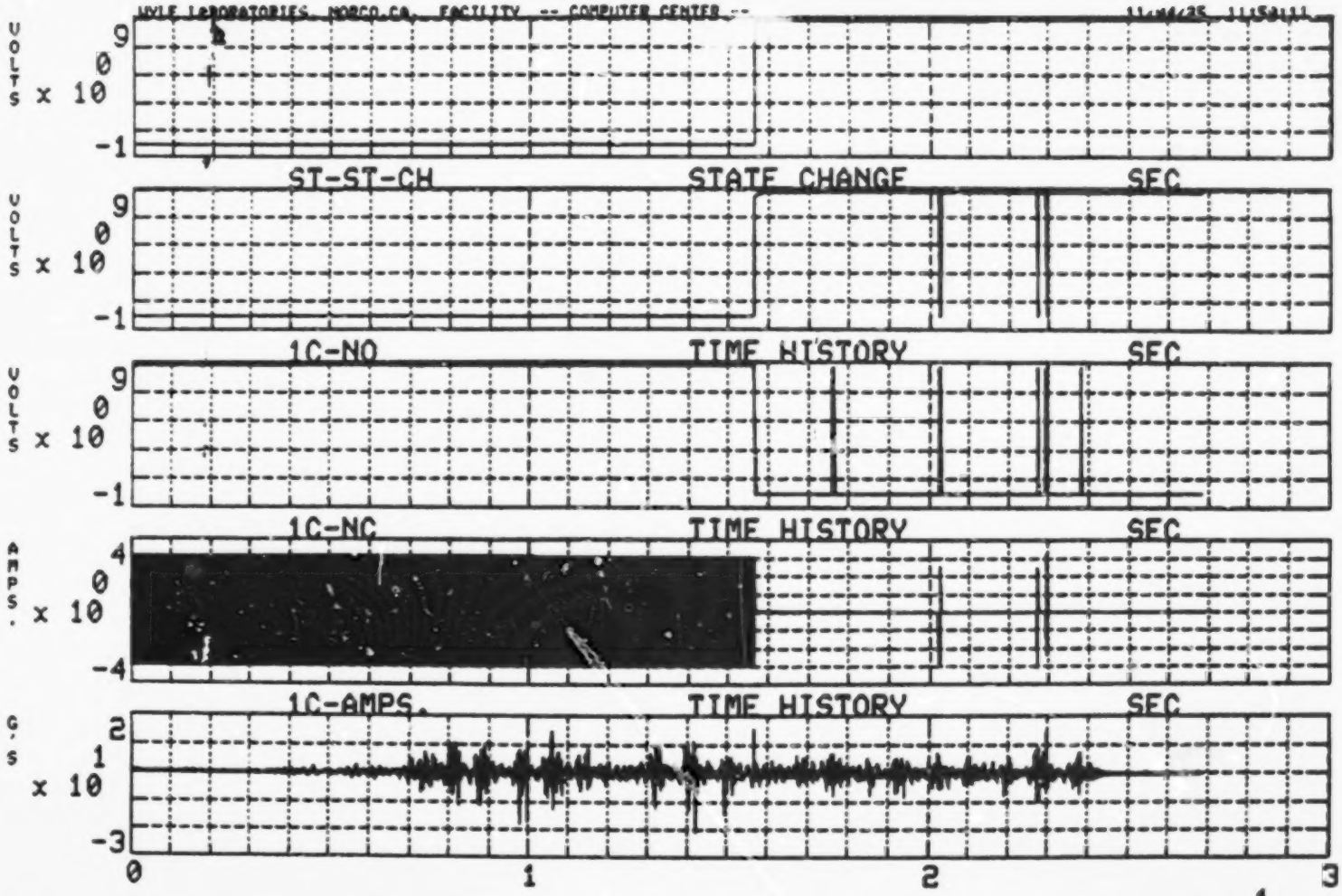
CHANNEL ID	CHANNEL NUMBER	FIRST CHATTER	LAST CHATTER	STATE CHANGE	NUMBER OF CHATTER FAILURES PER TIME LENGTH 2.00-5.00	5.00-10.0	10.0-20.0	20.0-40.0	40.0-80.0	>80.0	TOTAL
1C-NO	2	20.257	22.956	1	0	0	3	0	0	0	3
1C-NC	3	17.612	23.815	1	0	0	1	4	0	0	5
1C-AMPS	4	20.259	22.978	1	0	0	2	1	0	0	3
2B-W.NO	6	20.226	23.779	1	2	1	1	0	0	0	4
2B-W.NC	7	17.592	23.781	1	2	2	2	0	0	0	6
2B-X.NO	8	20.233	22.930	1	0	1	1	0	0	0	2
2B-X.NC	10	17.376	23.789	1	1	2	3	4	0	0	10
1G-NO	11			1	NO CHATTER						
1G-NC	12	20.259	22.730	1	1	0	0	1	0	0	2
1G-AMPS	13			1	NO CHATTER						
1J-W.NO	14			1	NO CHATTER						
1J-W.NC	15			1	NO CHATTER						
1J-KP.NO	16			1	NO CHATTER						
1J-KP.NC	17			1	NO CHATTER						
1M-NO	18			1	NO CHATTER						
1M-NC	19			1	NO CHATTER						
1M-AMPS	20			1	NO CHATTER						
2E-FW.NO	21			0	NO CHATTER						
2E-FW.NC	22	15.738	23.768	1	0	0	0	0	1	10	11
2E-RV.NO	23			1	NO CHATTER						
2E-RV.NC	24	18.504	23.775	1	0	2	3	1	0	0	6
2E-AMPS	25			1	NO CHATTER						
2J-W.NO	26			1	NO CHATTER						
2J-W.NC	27			1	NO CHATTER						
2J-GE.NO	28			1	NO CHATTER						
2J-GE.NC	29			1	NO CHATTER						
2J-KP.NO	30			1	NO CHATTER						
2J-KP.NC	31			1	NO CHATTER						
2J-X.NO	32			1	NO CHATTER						
2J-X.NC	33	17.566	23.757	1	1	2	2	0	0	0	5
2J-CH.NO	34			1	NO CHATTER						
2J-CH.NC	35			1	NO CHATTER						
2M-NO	36			1	NO CHATTER						
2M-NC	38			1	NO CHATTER						
2M-AMPS	39			1	NO CHATTER						
3B-NO	40	22.927	22.929	1	1	0	0	0	0	0	1
3B-NC	42	20.229	22.938	1	0	0	1	0	0	0	1
3B-AMPS	43			1	NO CHATTER						
3D-GE.NO	44			1	NO CHATTER						

Page No. B-313

Report No. 26448

TEST NAME=LLNL 26447, RUN 31, X-Y AXIS, 4TH LEVEL/12 BOLTS, ON-OFF RV,
TEST DATE=10/25/85 15:23: 3 HOURS

CHANNEL ID	CHANNEL NUMBER	FIRST CHATTER	LAST CHATTER	STATE CHANGE	NUMBER OF CHATTER FAILURES PER TIME LENGTH 2.00-5.00	5.00-10.0	10.0-20.0	20.0-40.0	40.0-80.0	>80.0	TOTAL
3D-GE.NC	45			1	NO CHATTER						
3D-CH.NO	46			1	NO CHATTER						
3D-CH.NC	47			1	NO CHATTER						
3D-KP.NO	48			1	NO CHATTER						
3D-KP.NC	49	15.684	15.727	1	3	0	0	0	0	0	3
3G-NO	50			1	NO CHATTER						
3G-NC	51			1	NO CHATTER						
3G-AMPS	52			1	NO CHATTER						
3J-GE1NO	53			1	NO CHATTER						
3J-GE1NC	54			1	NO CHATTER						
3J-GE2NO	55			1	NO CHATTER						
3J-GE2NC	56			1	NO CHATTER						
3M-FW.NO	57			0	NO CHATTER						
3M-FW.NC	58	15.714	22.898	1	0	0	0	0	1	5	6
3M-RV.NO	59			1	NO CHATTER						
3M-RV.NC	60	15.711	20.012	1	1	1	0	0	0	0	2
3M-AMPS	61			1	NO CHATTER						
ST-ST-CH	62				STATE SW. # 2		CHANGE AT 15.634				
RL-ST-CH	63				STATE SW. # 1		CHANGE AT 15.679				
										TOTAL=	72



ACC-8 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 10/25/85 DISPLAY NUMBER 1 .00 TO 26.86 SEC

LLNL 26447, RUN 31, X-Y AXIS, 4TH LEVEL/12 BOLTS, ON-OFF RV,

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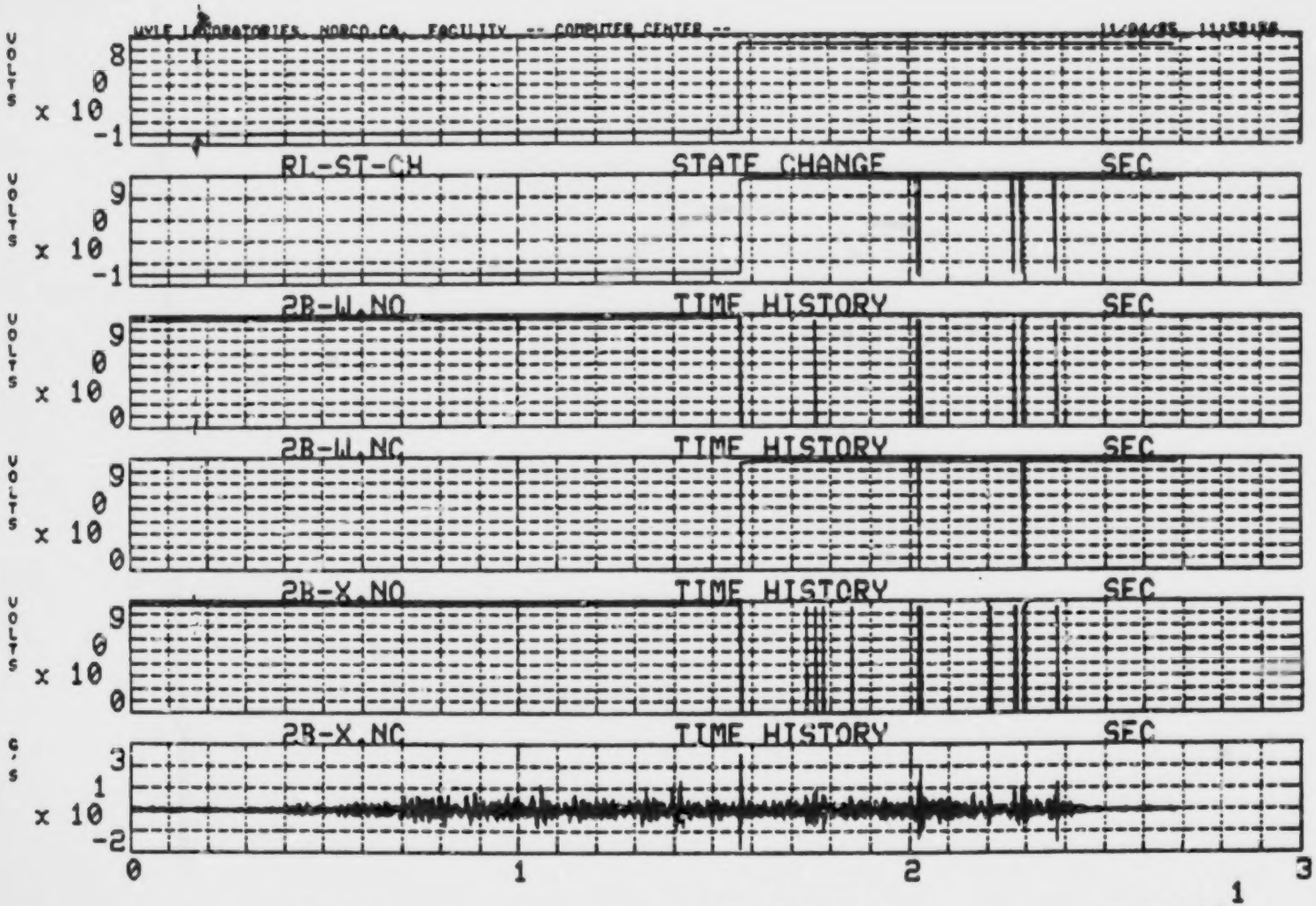


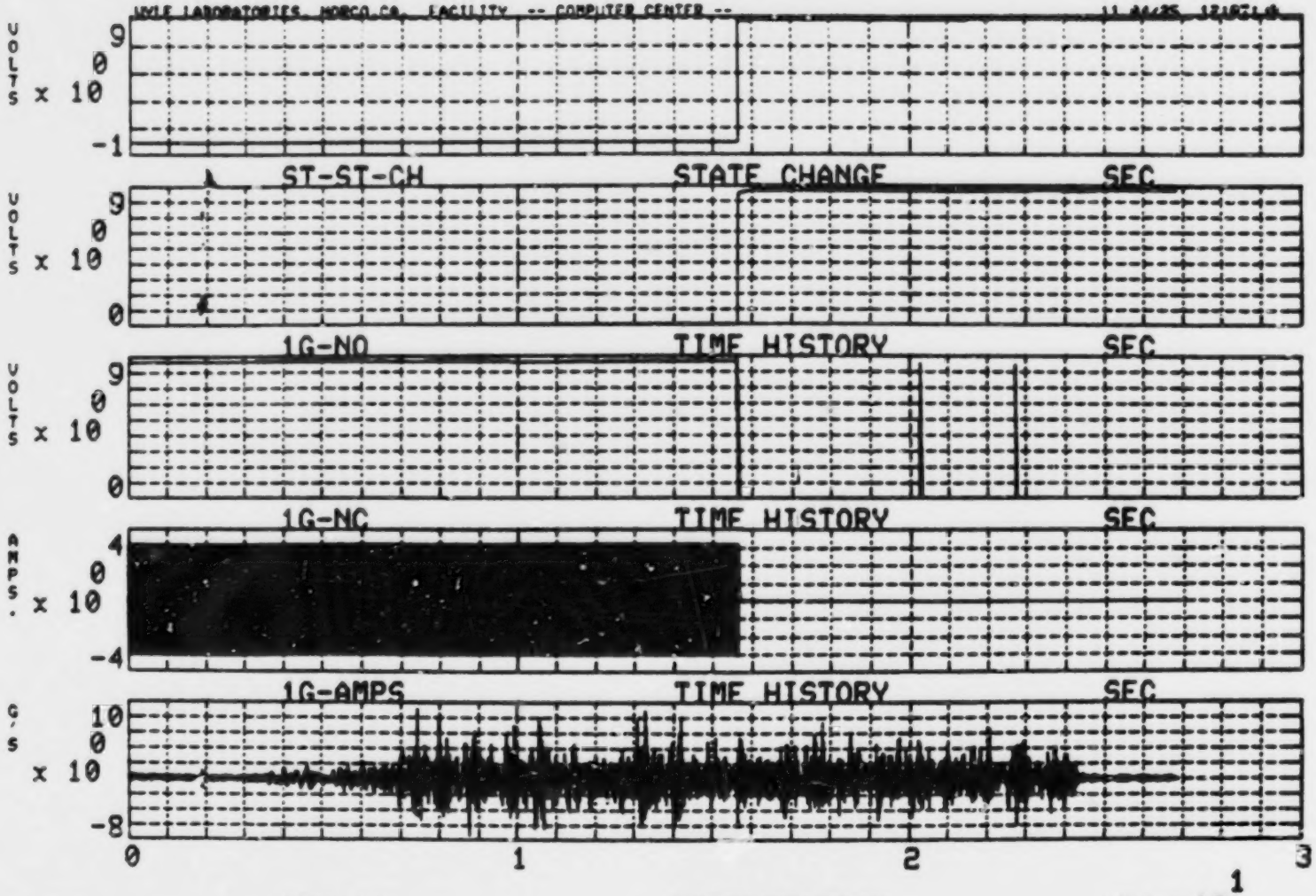
ACC-10 ACCELERATION SEC x 10^{1}

NO FILTER, 1000.00 SPS,

DATE 10/25/85 DISPLAY NUMBER 2 .00 TO 26.86 SEC

LLNL 26447, RUN 31, X-Y AXIS, 4TH LEVEL/12 BOLTS, ON-OFF RV,

BEST COPY AVAILABLE



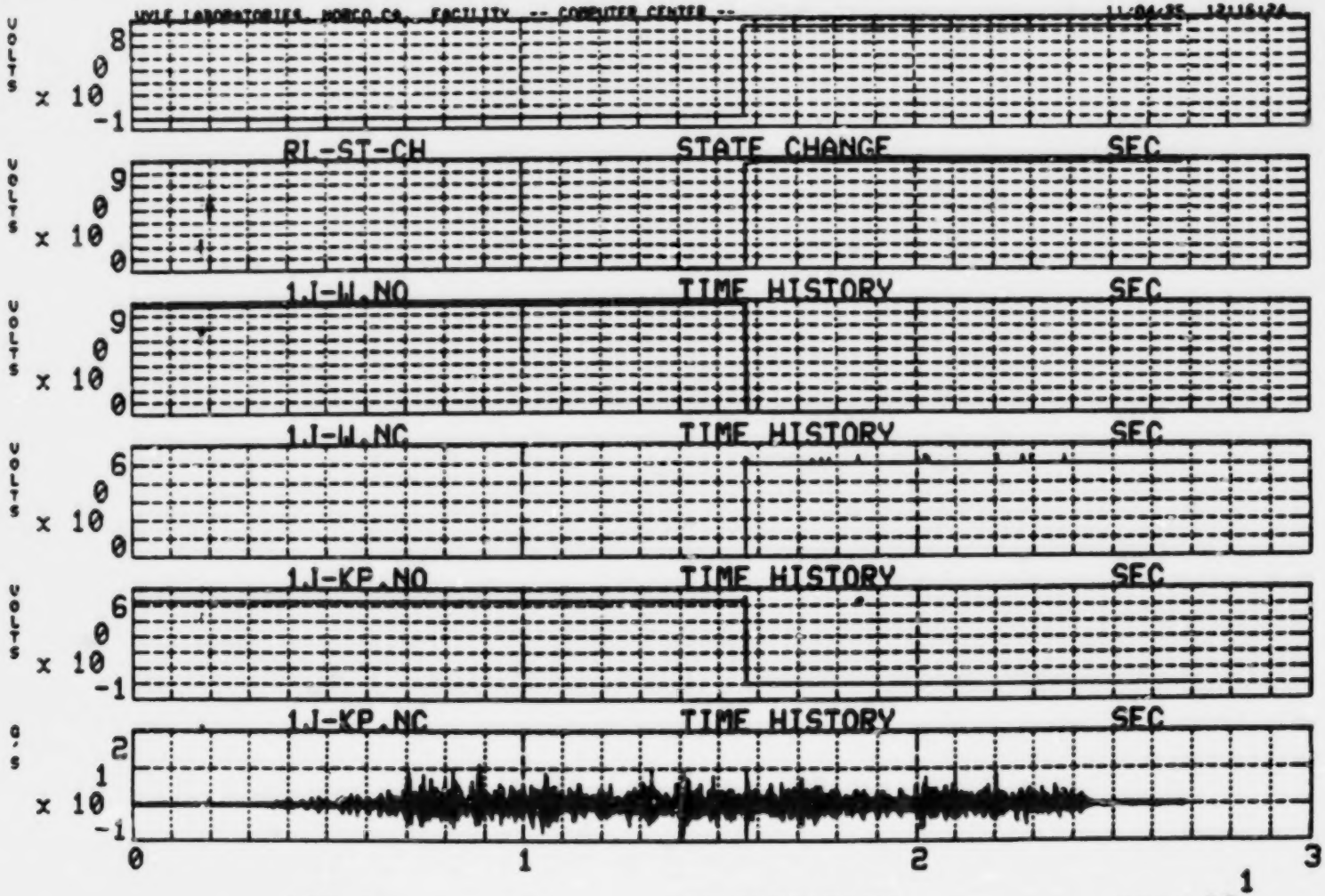
ACC-14 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 10/25/85 DISPLAY NUMBER 3 .00 TO 26.86 SEC

LLNL 26447, RUN 31, X-Y AXIS, 4TH LEVEL/12 BOLTS, ON-OFF RV,

BEST COPY AVAILABLE



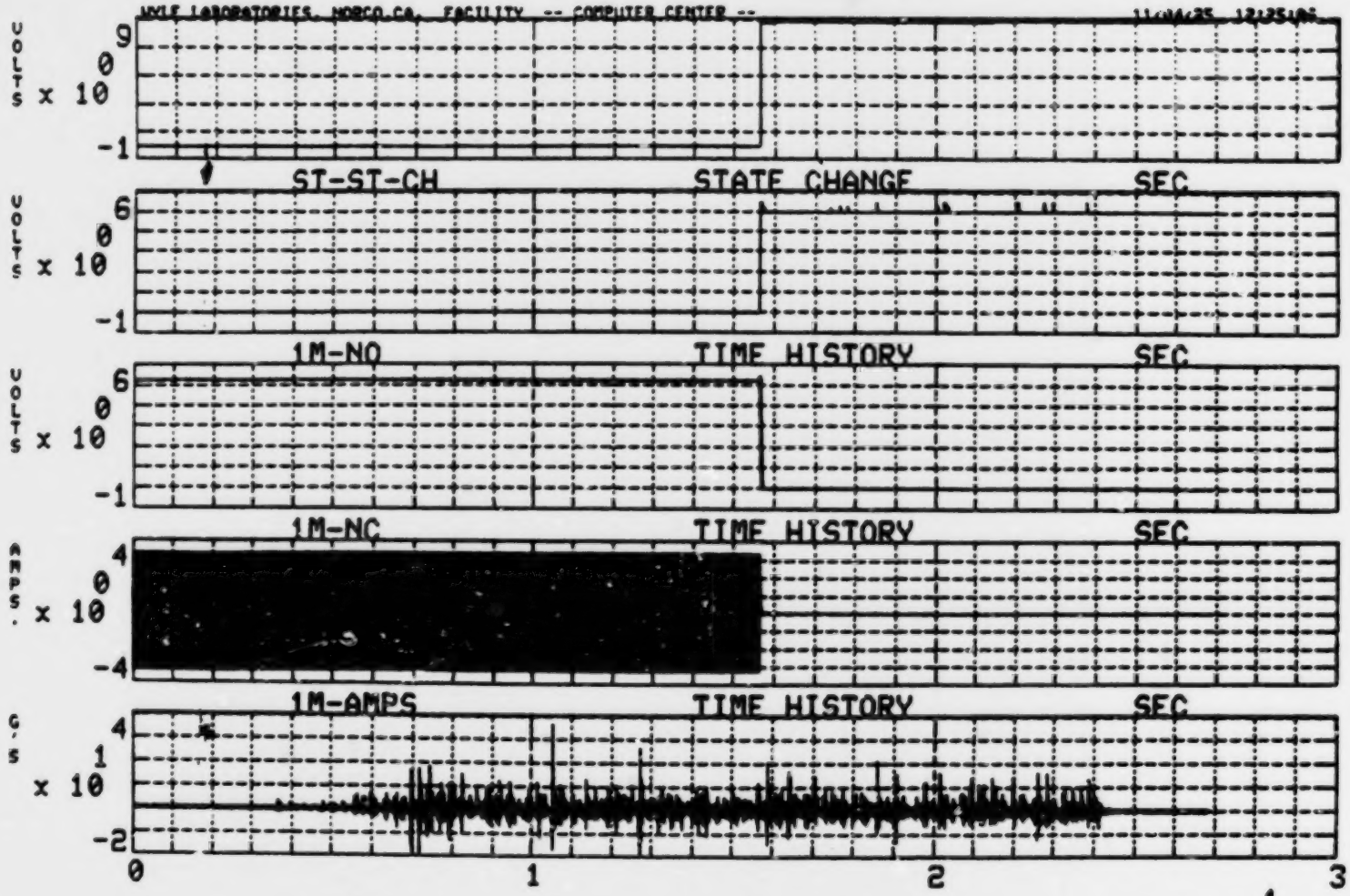
ACC-3 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 10/25/85 DISPLAY NUMBER 4 .00 TO 26.86 SEC

LLNL 26447, RUN 31, X-Y AXIS, 4TH LEVEL/12 BOLTS, ON-OFF RV,

BEST COPY AVAILABLE



ACC-18 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 10/25/85 DISPLAY NUMBER 5 .00 TO 26.86 SEC

LLNL 26447, RUN 31, X-Y AXIS, 4TH LEVEL/12 BOLTS, ON-OFF RV,

Report No. 26448

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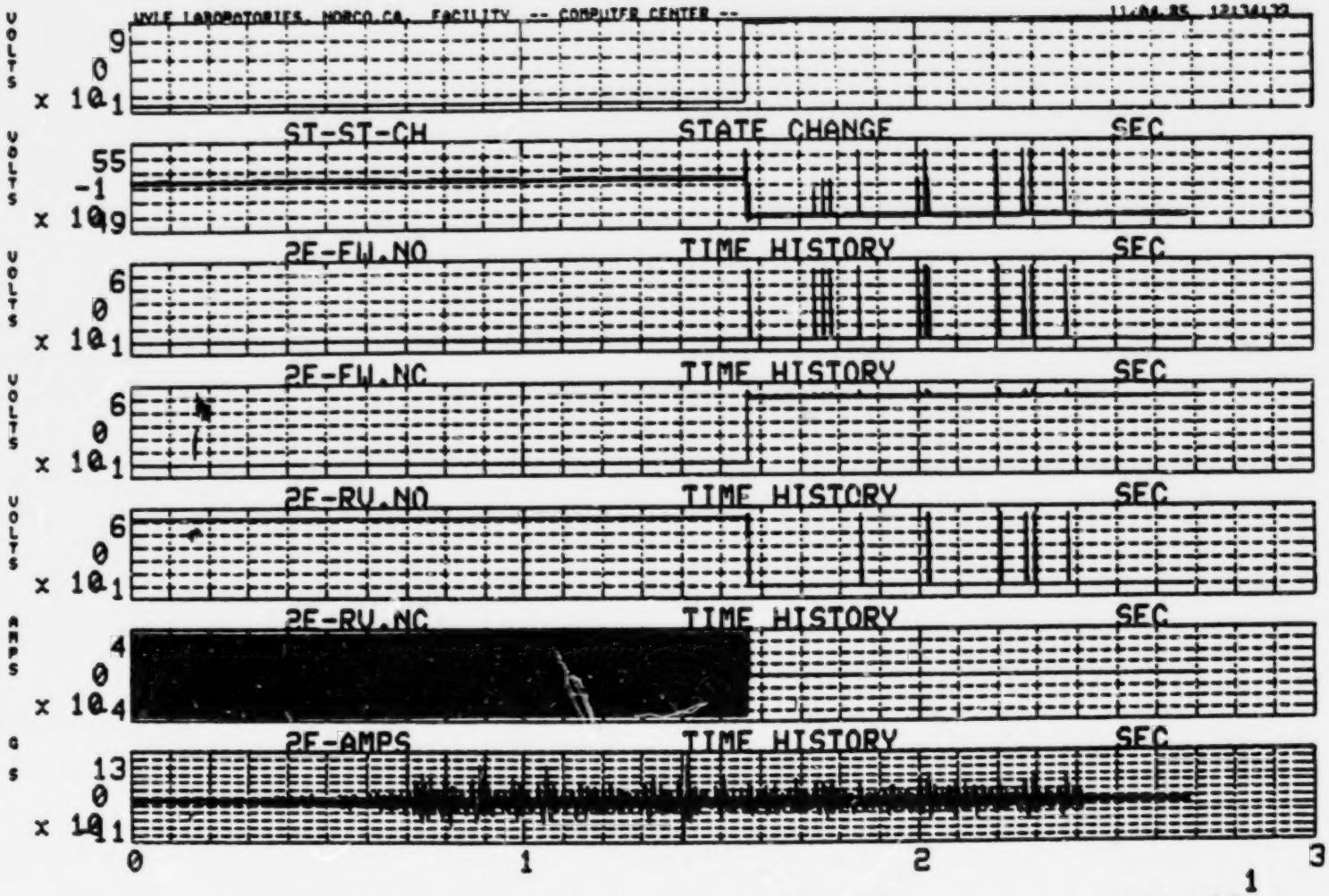


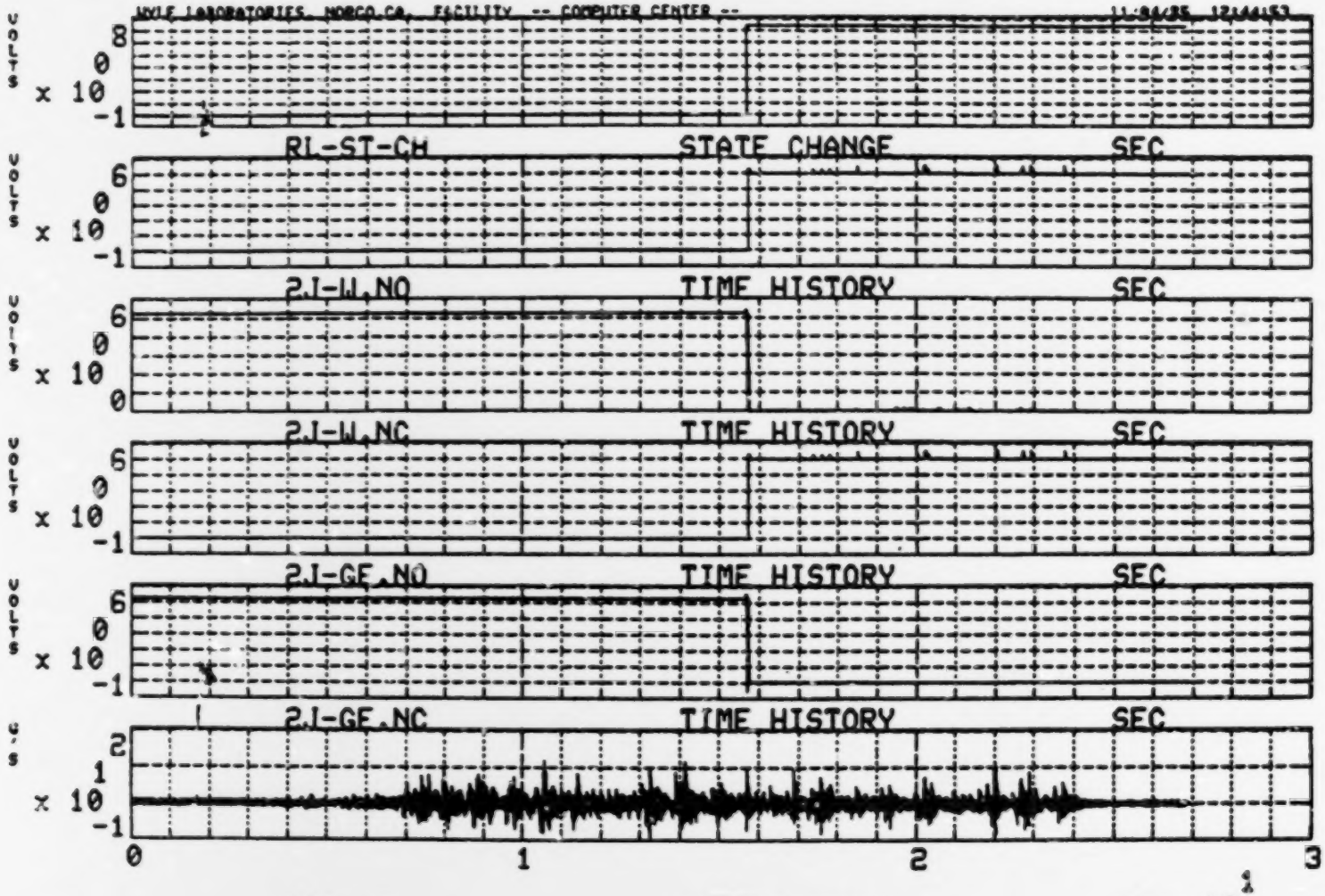
ACC-11 ACCELERATION SEC x 10 1

NO FILTER, 1000.00 SPS,

DATE 10/25/85 DISPLAY NUMBER 6 .00 TO 26.86 SEC

LLNL 26447, RUN 31, X-Y AXIS, 4TH LEVEL/12 BOLTS, ON-OFF RV,

BEST COPY AVAILABLE



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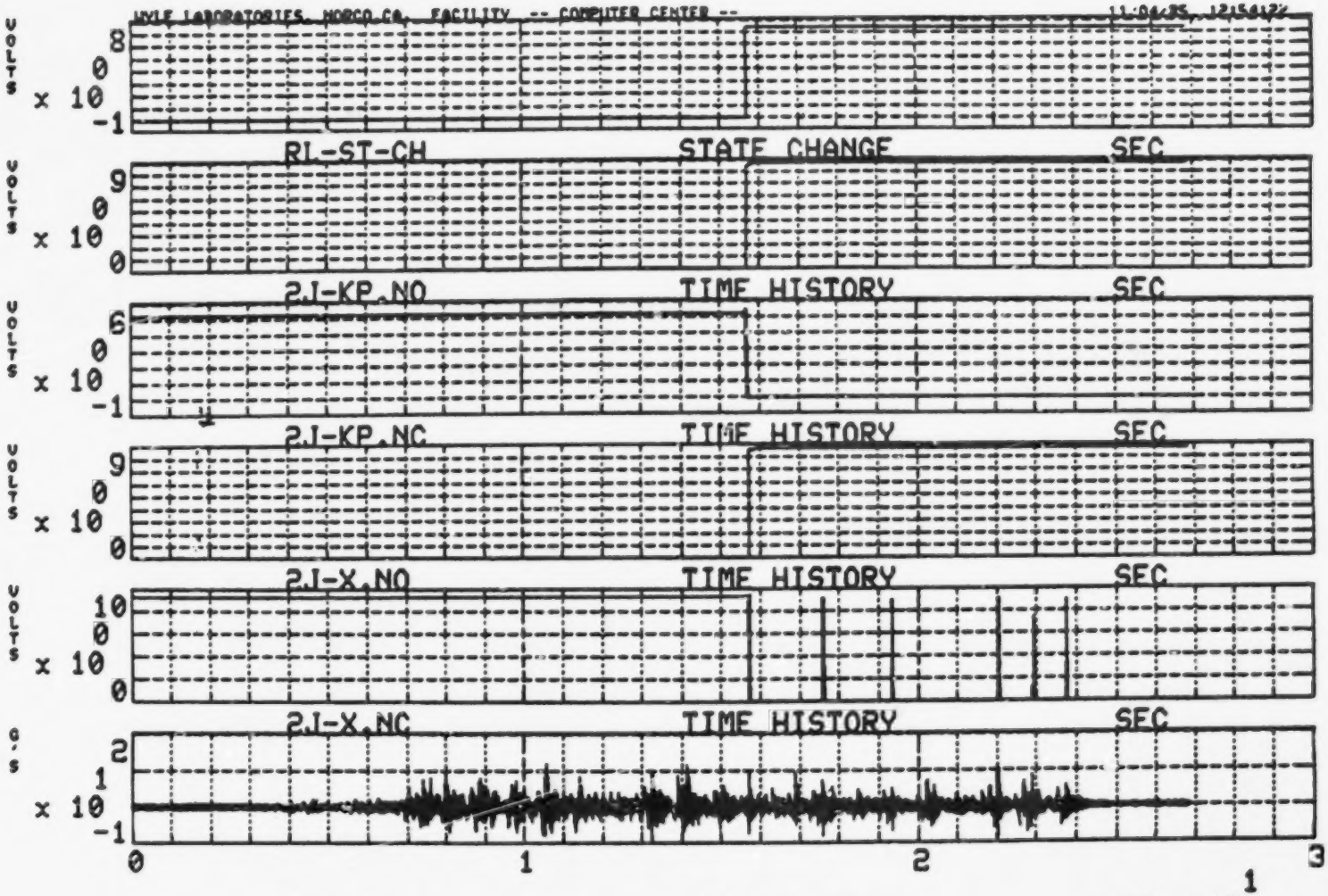

ACC-15 ACCELERATION SEC x 10^{1}

NO FILTER, 1000.00 SPS,

DATE 10/25/85 DISPLAY NUMBER 8 .00 TO 26.86 SEC

LLNL 26447, RUN 31, X-Y AXIS, 4TH LEVEL/12 BOLTS, ON-OFF RV,

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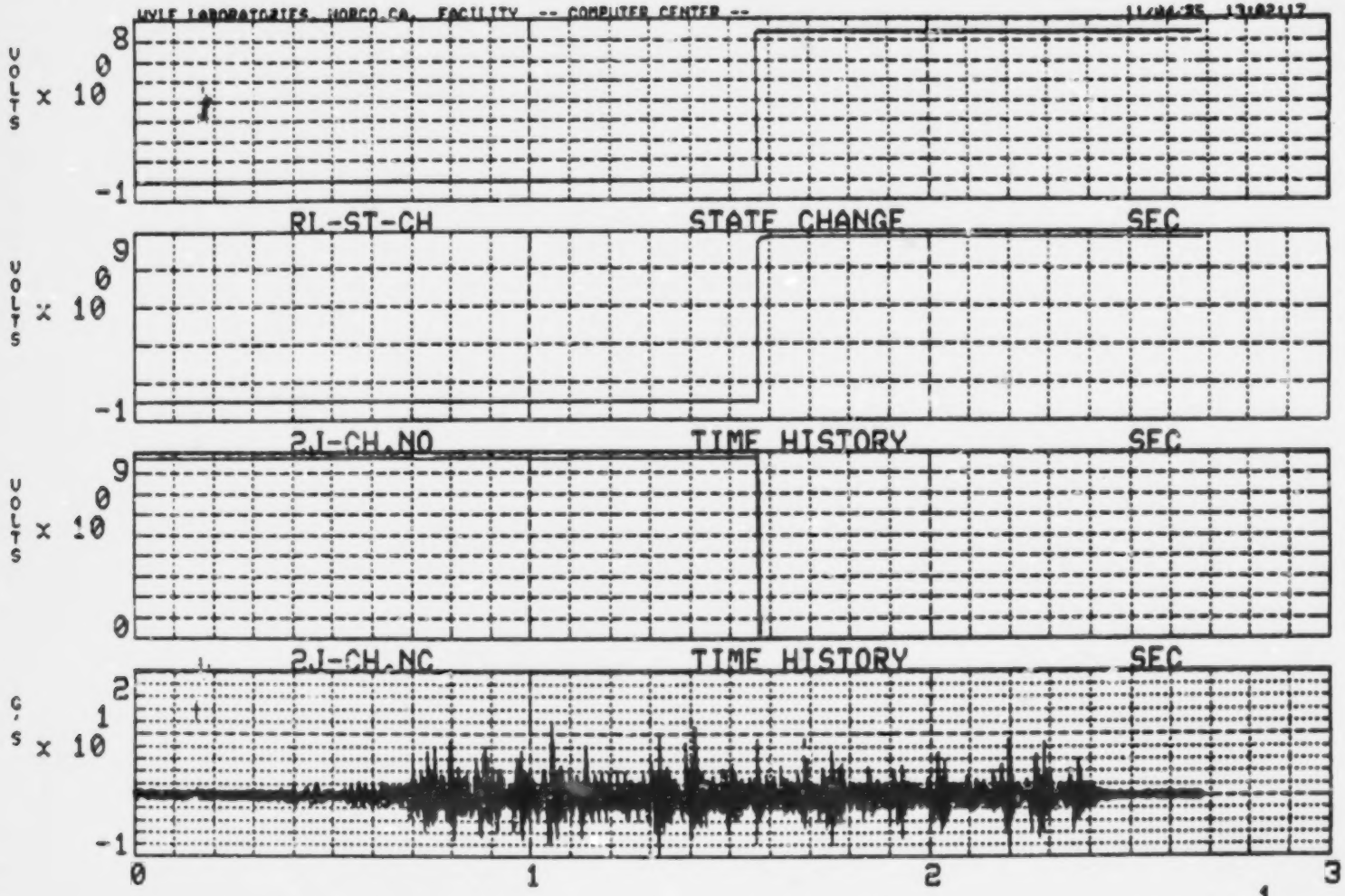

ACC-15 ACCELERATION SEC x 10^{1}

NO FILTER, 1000.00 SPS,

DATE 10/25/85 DISPLAY NUMBER 9 .00 TO 26.86 SEC

LLNL 26447, RUN 31, X-Y AXIS, 4TH LEVEL/12 BOLTS, ON-OFF RV,

Report No. 26448

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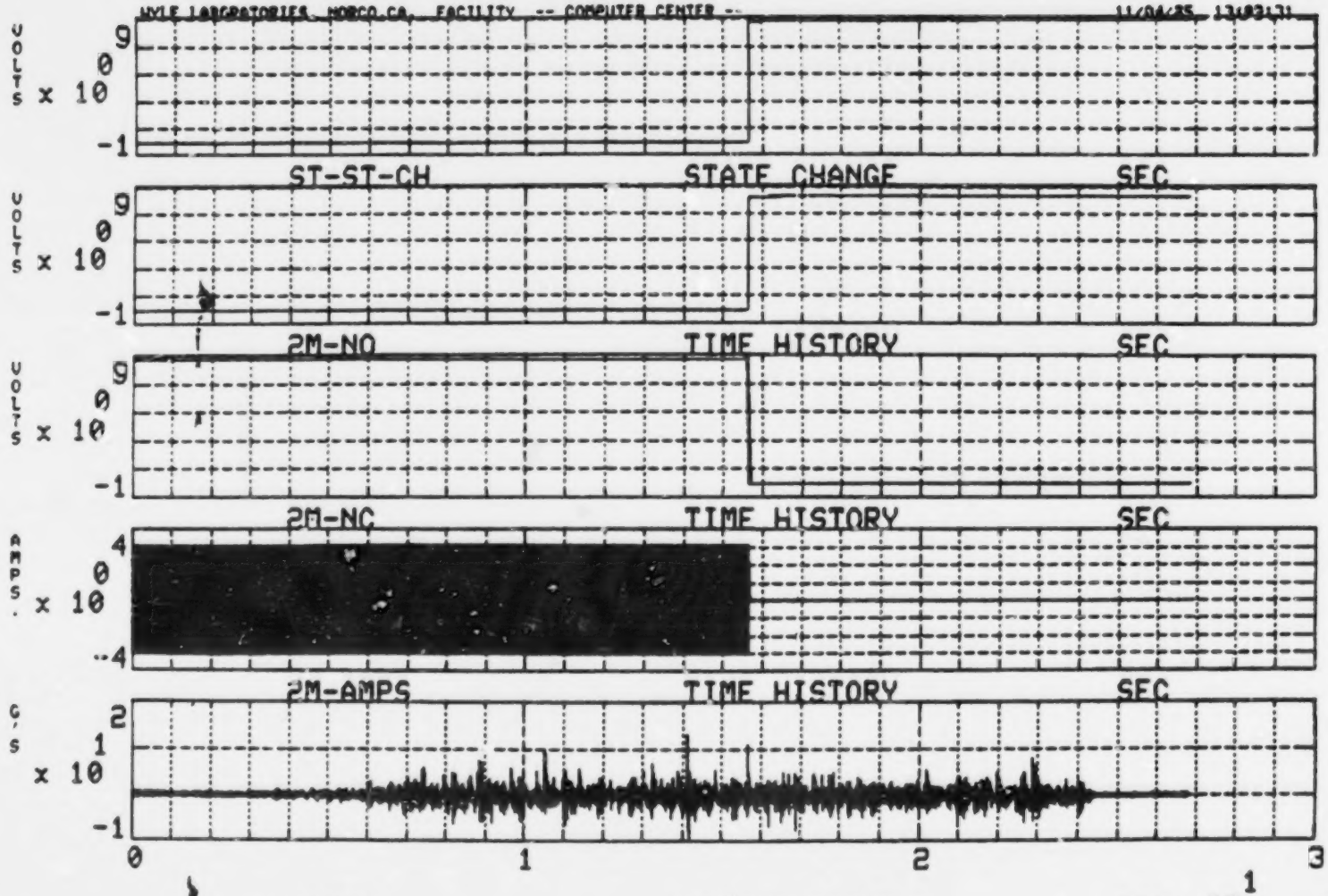
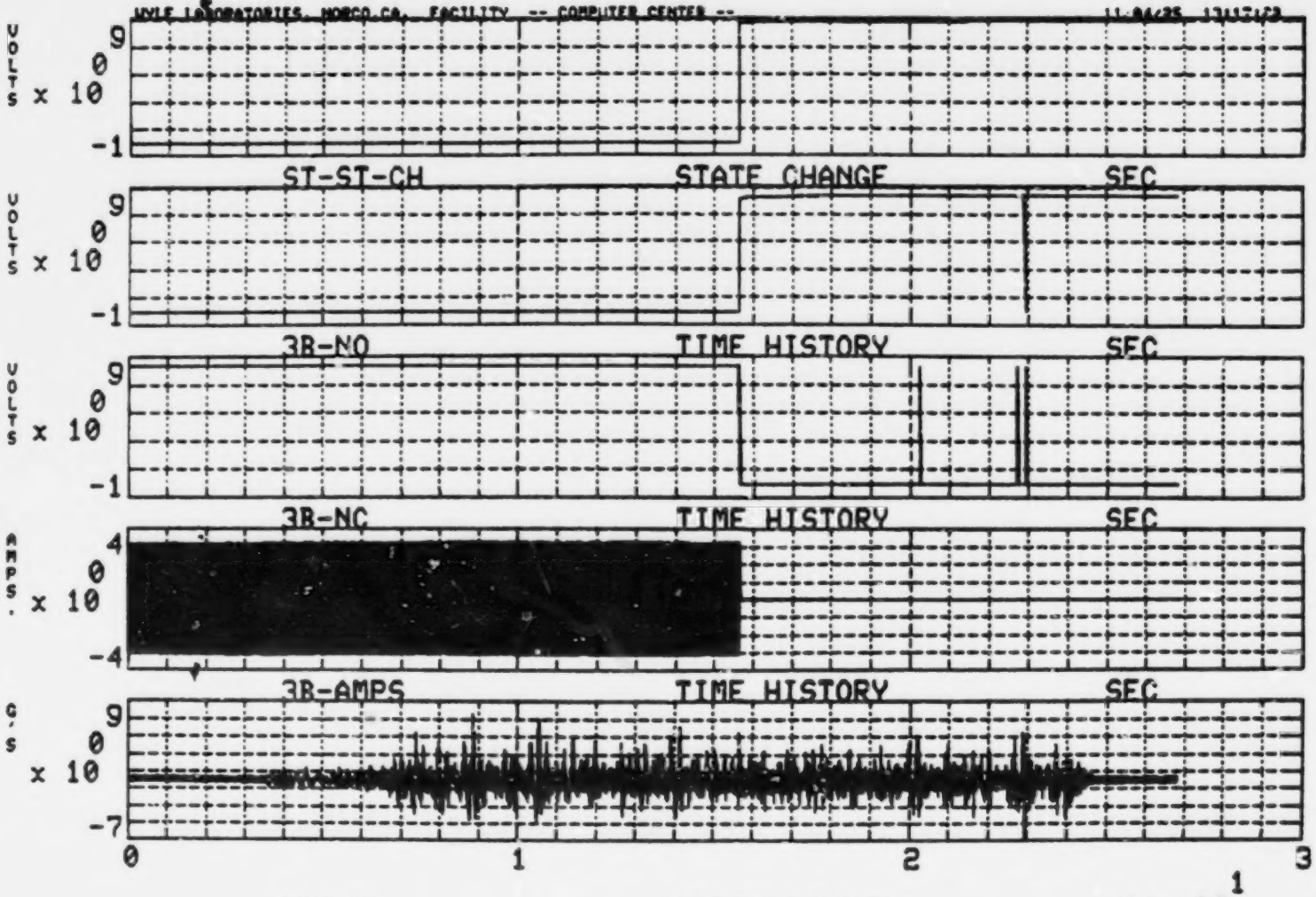


BEST COPY AVAILABLE



ACC-9 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 10/25/85 DISPLAY NUMBER 11 .00 TO 26.86 SEC

LLNL 26447, RUN 31, X-Y AXIS, 4TH LEVEL/12 BOLTS, ON-OFF RV,

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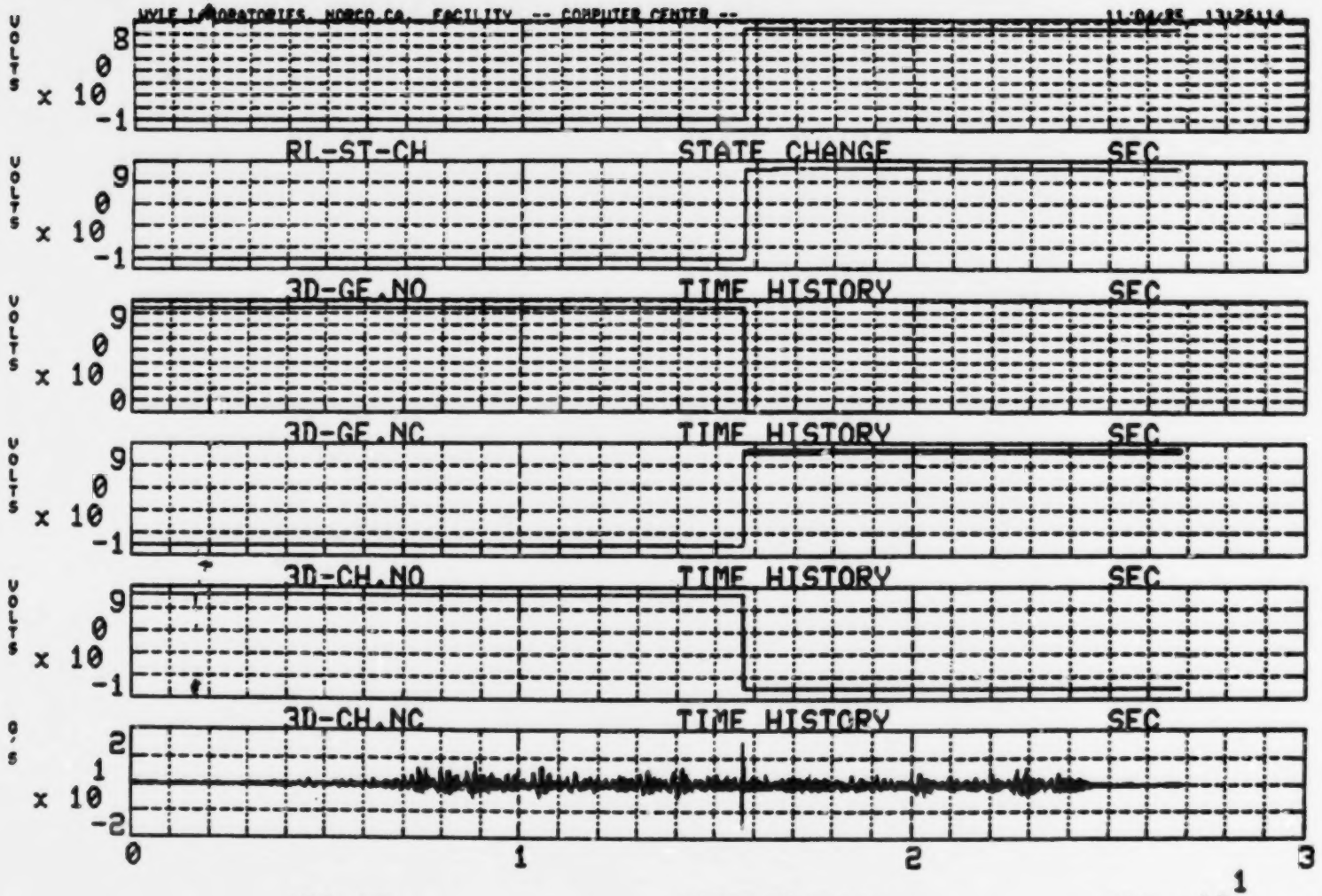
201



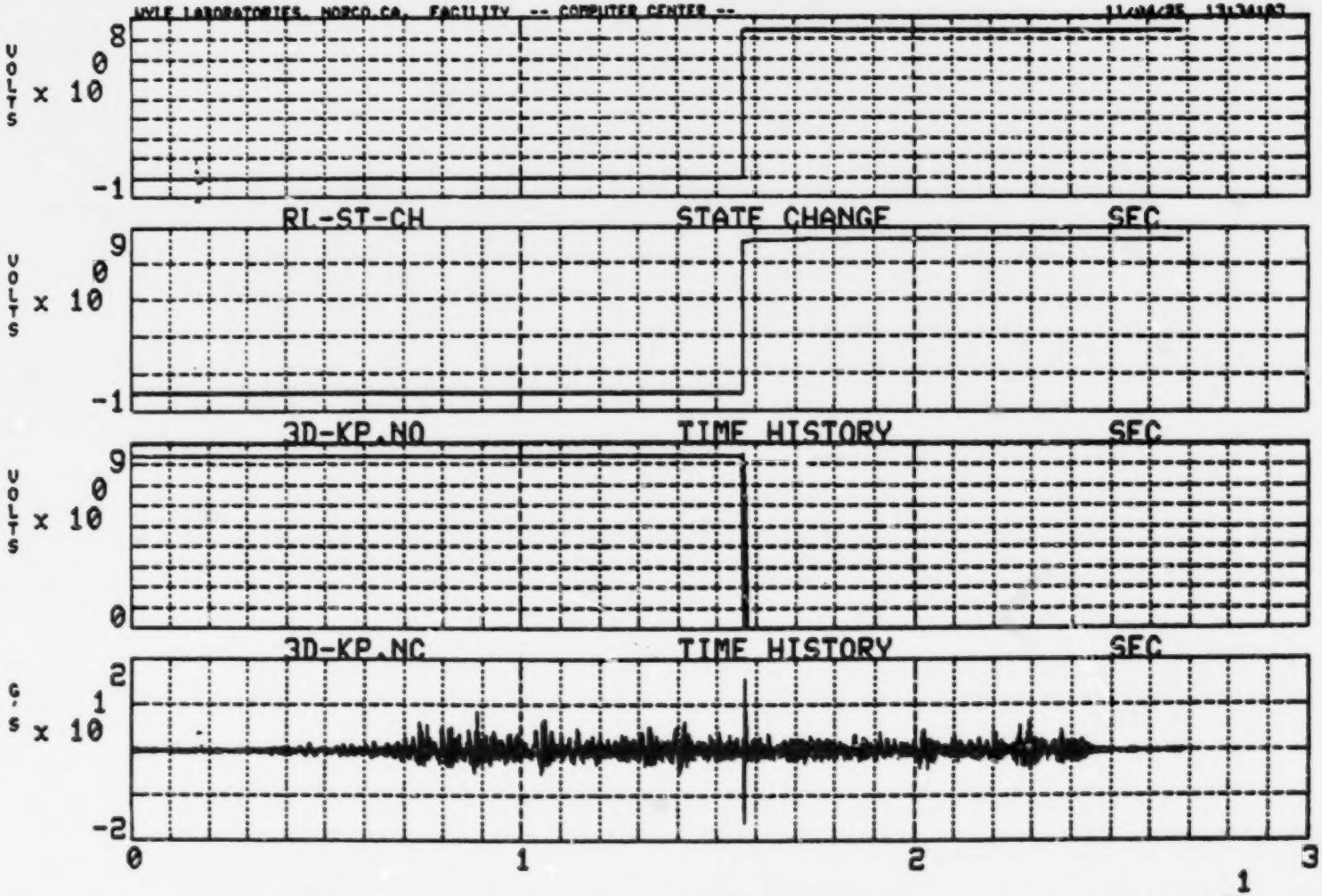
ACC-13 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 10/25/85 DISPLAY NUMBER 12 .00 TO 26.86 SEC

LLNL 26447, RUN 31, X-Y AXIS, 4TH LEVEL/12 BOLTS, ON-OFF RV,

BEST COPY AVAILABLE



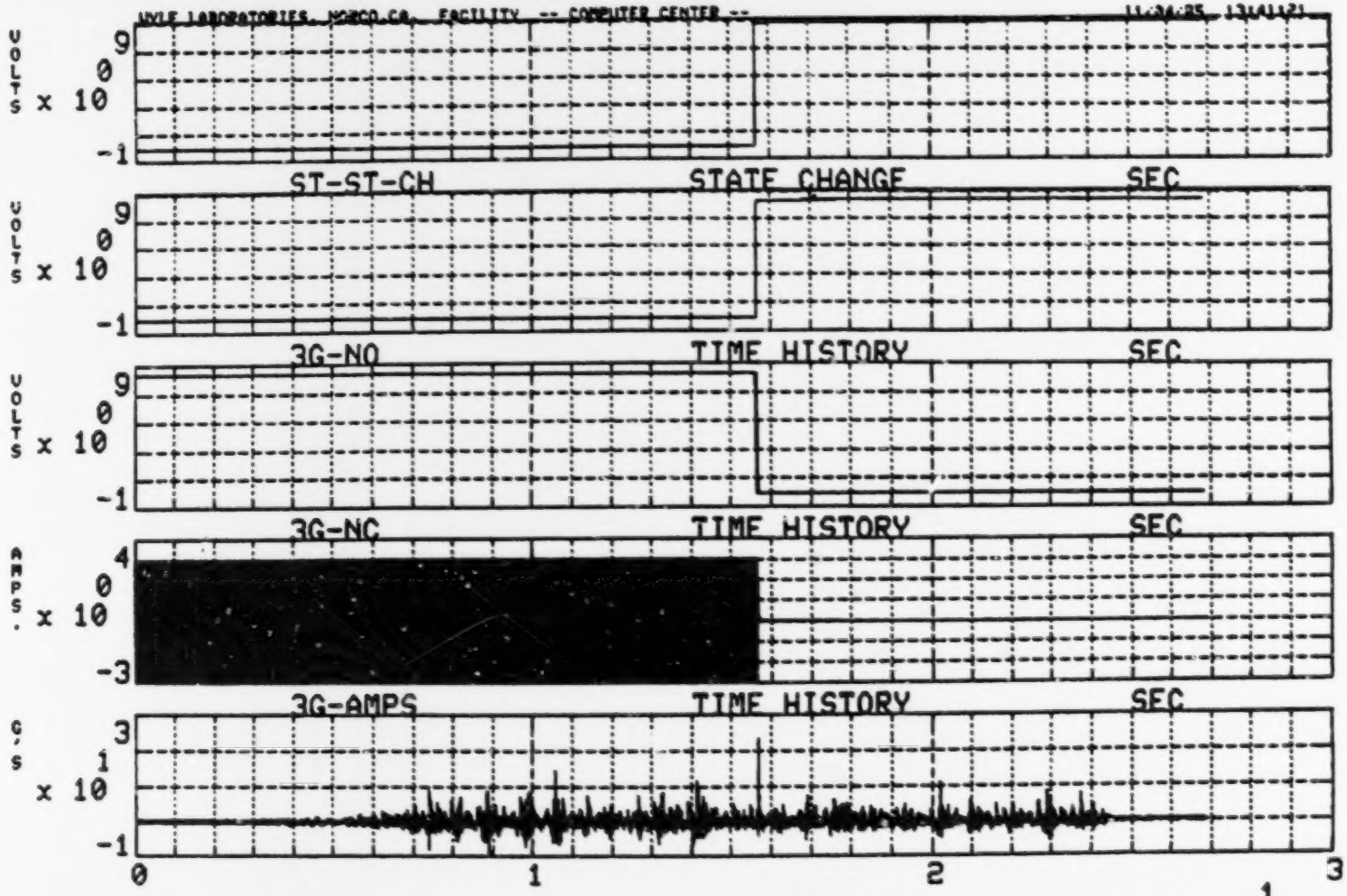
ACC-13 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 10/25/85 DISPLAY NUMBER 13 .00 TO 26.86 SEC

LLNL 26447, RUN 31, X-Y AXIS, 4TH LEVEL/12 BOLTS, ON-OFF RV,

BEST COPY AVAILABLE



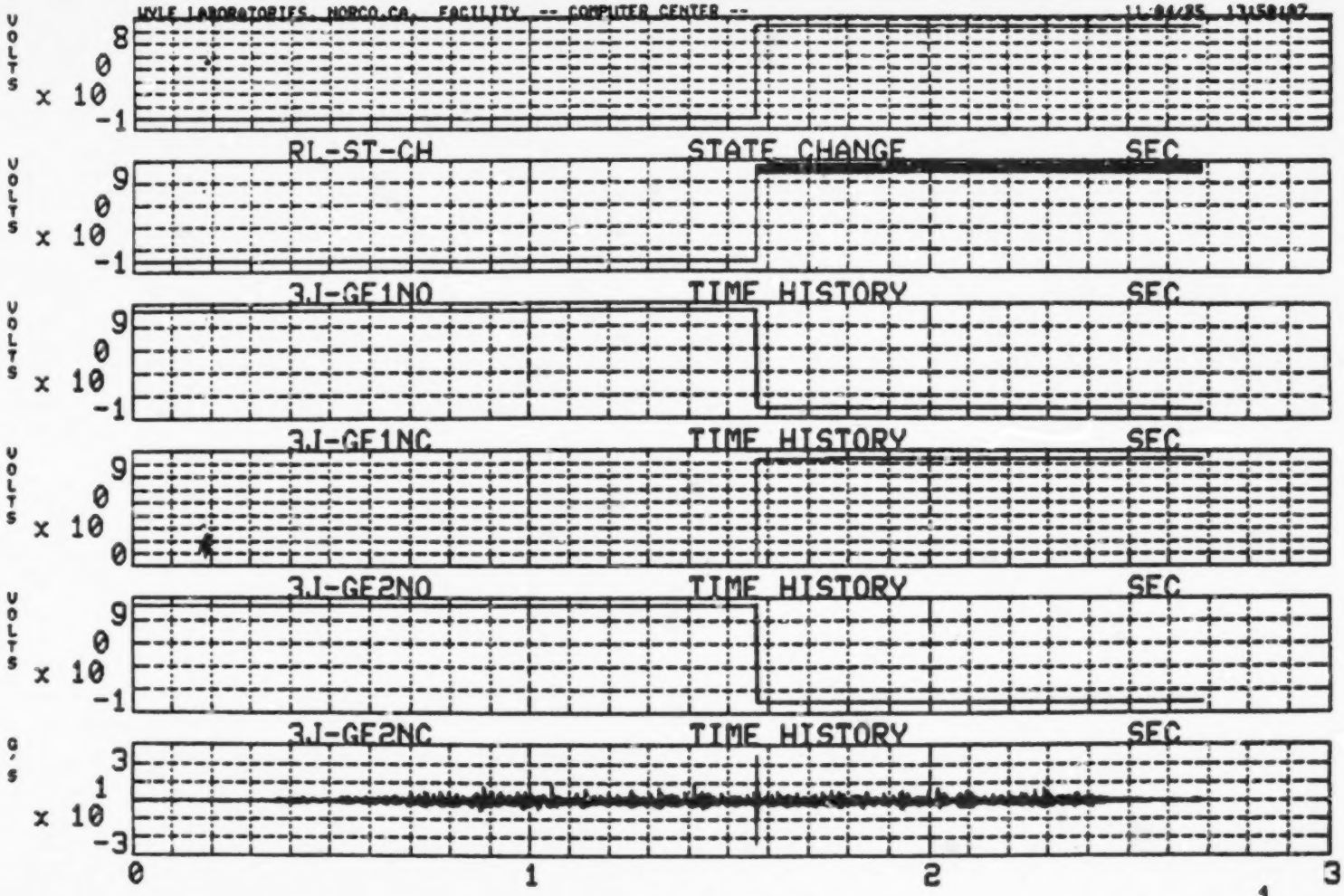
ACC-16 ACCELERATION SEC x 10 1

NO FILTER, 1000.00 SPS,

DATE 10/25/85 DISPLAY NUMBER 14 .00 TO 26.86 SEC

LLNL 26447, RUN 31, X-Y AXIS, 4TH LEVEL/12 BOLTS, ON-OFF RV,

BEST COPY AVAILABLE



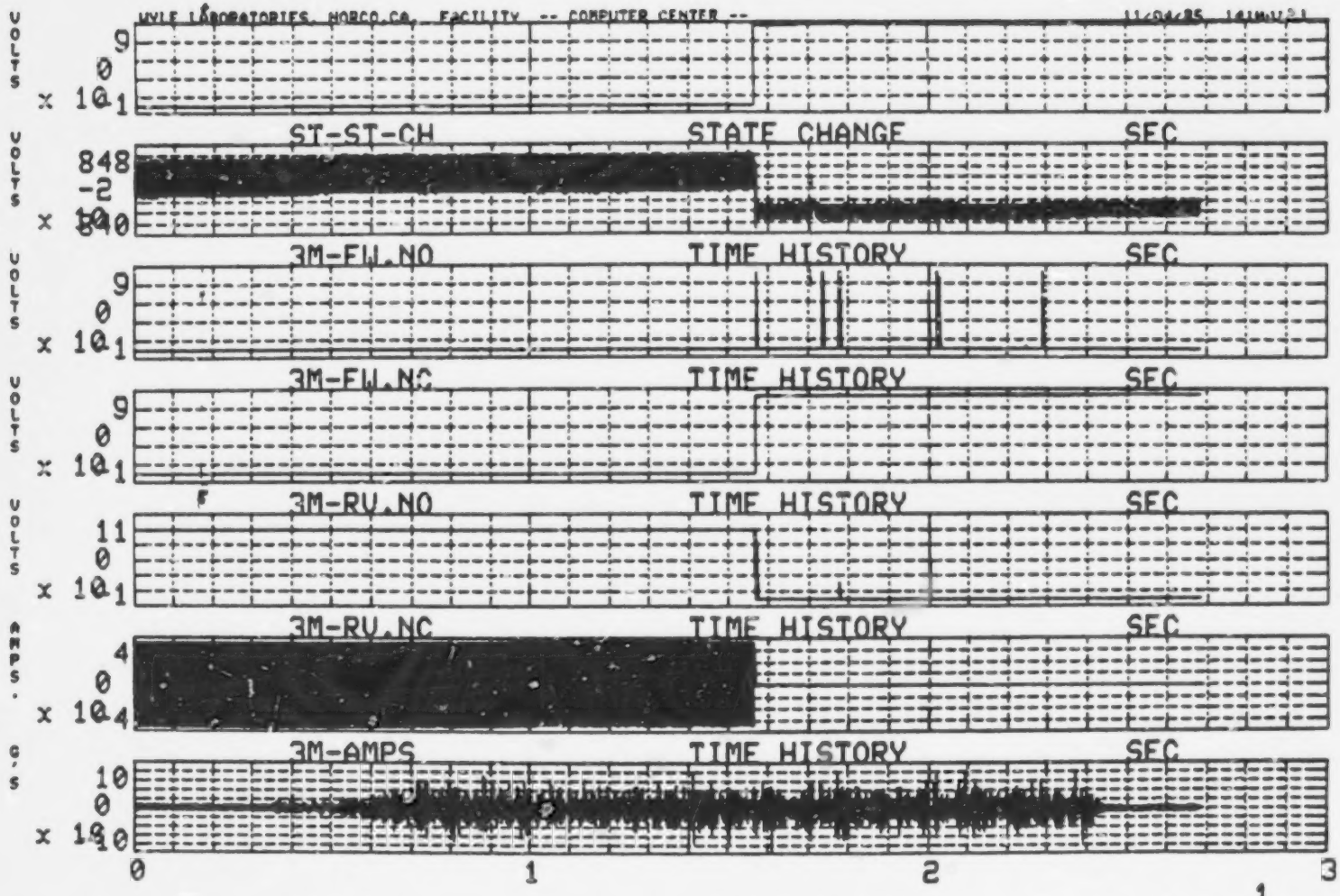
ACC-17 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 10/25/85 DISPLAY NUMBER 15 .00 TO 26.86 SEC

LLNL 26447, RUN 31, X-Y AXIS, 4TH LEVEL/12 BOLTS, ON-OFF RV,

BEST COPY AVAILABLE



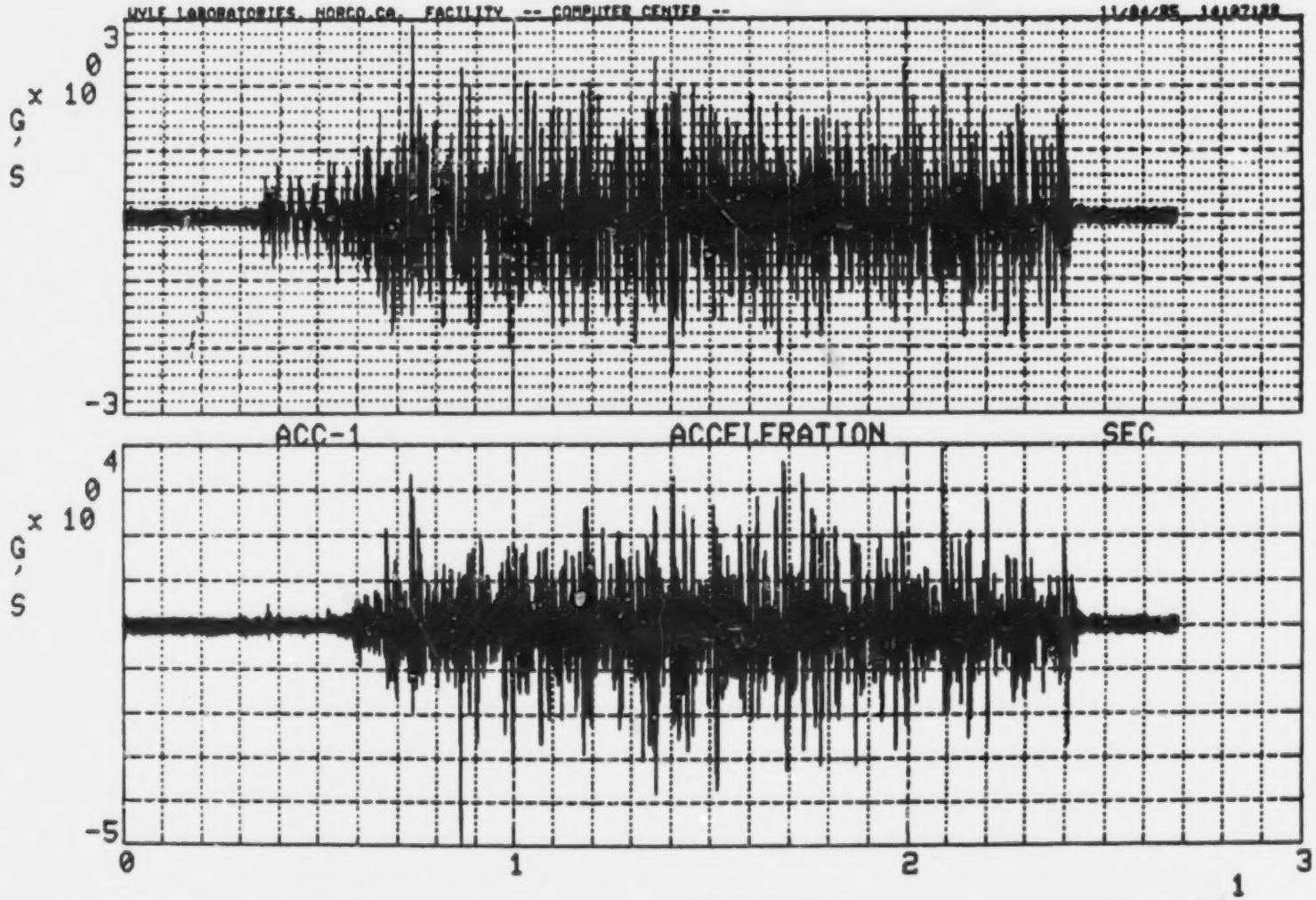
ACC-19 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 10/25/85 DISPLAY NUMBER 16 .00 TO 26.86 SEC

LLNL 26447, RUN 31, X-Y AXIS, 4TH LEVEL/12 BOLTS, ON-OFF RV,

BEST COPY AVAILABLE



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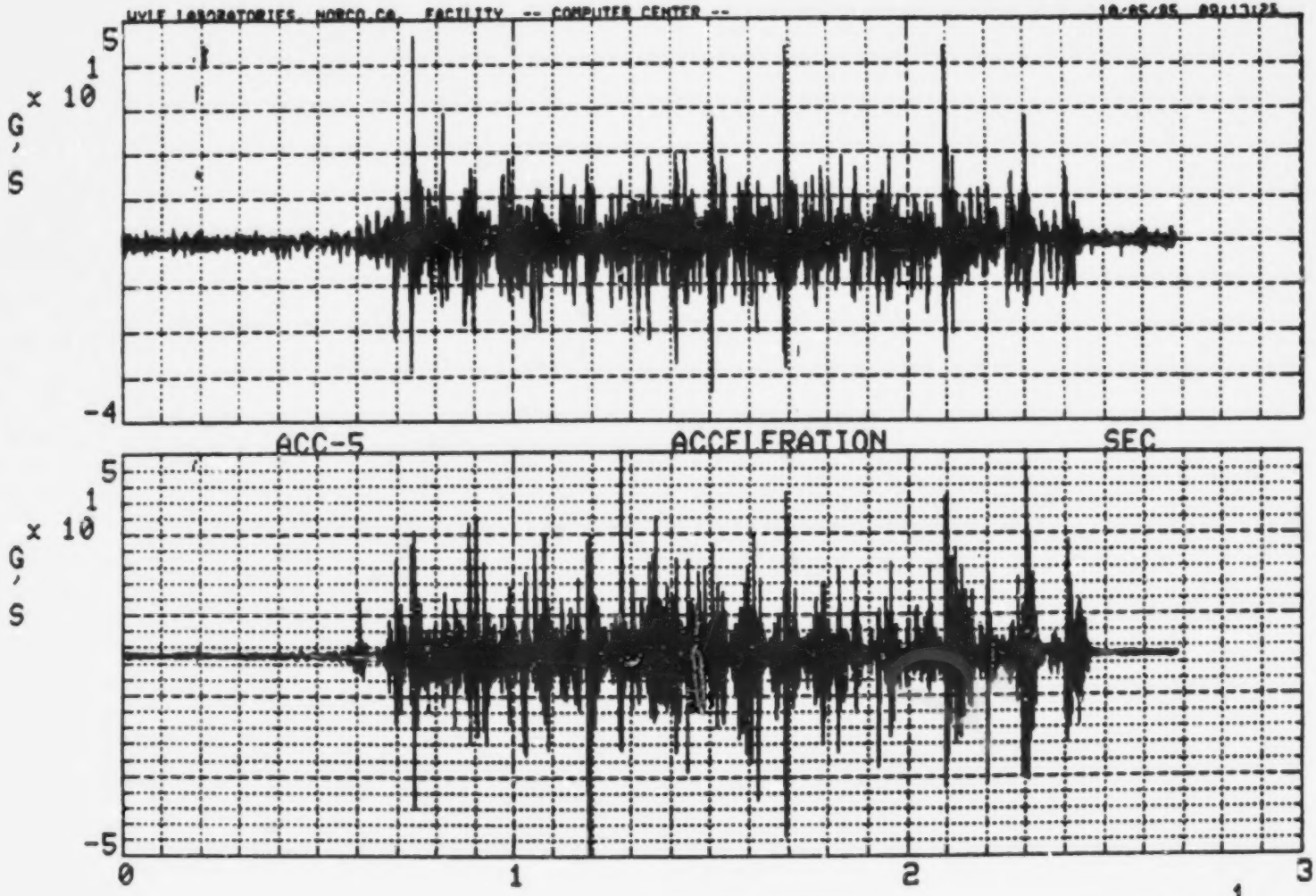

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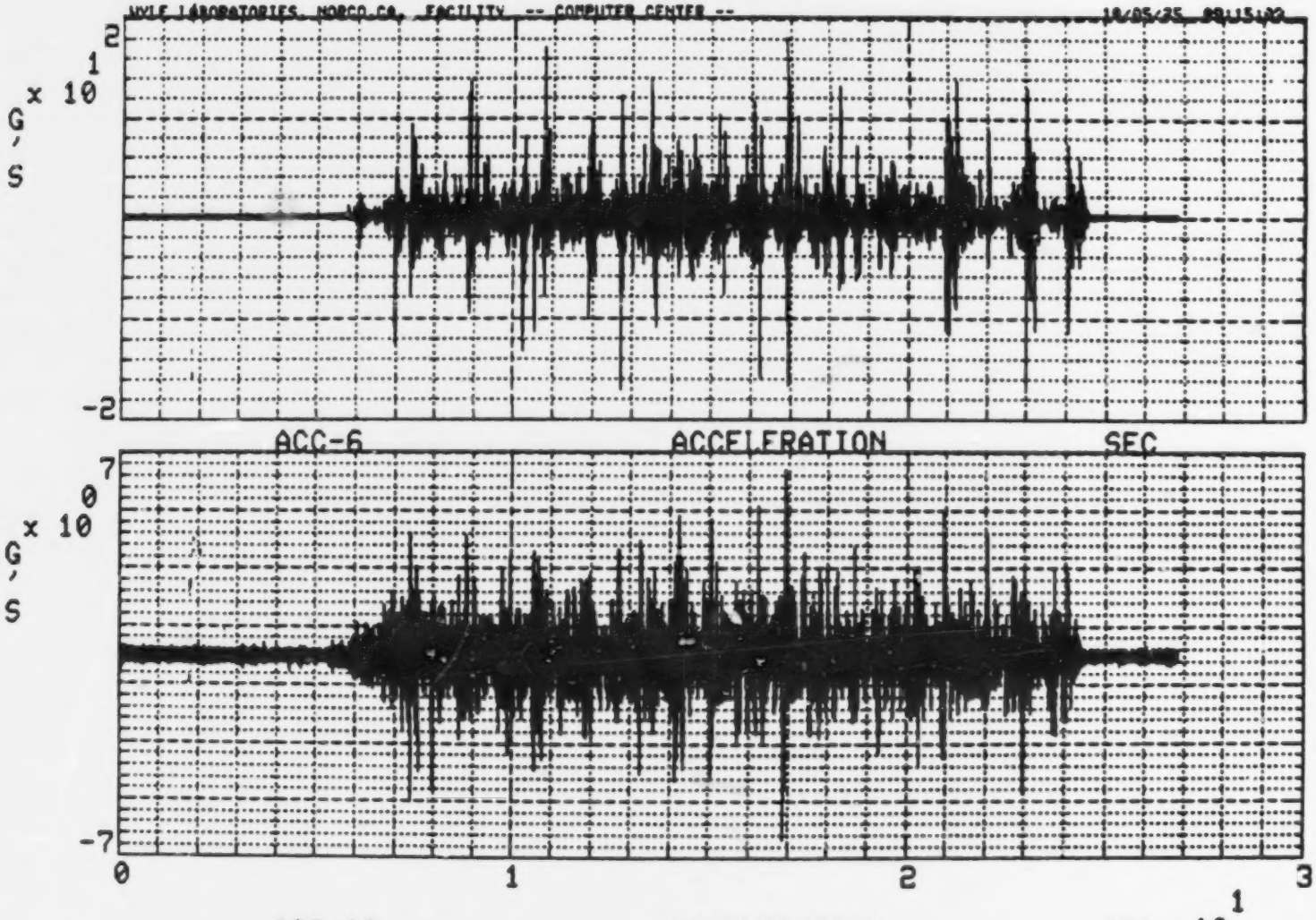

BEST COPY AVAILABLE

RUN 46

Two bolts per column with no top brace, 2.5g table ZPA

WYLE LABORATORIES,NORCO,CA. FACILITY CHATTER AND PULSE ANALYSIS PROGRAM 12/05/85 16:15:56 HOURS PAGE 1

START TIME= 0.0000 STOP TIME= 26.980

TEST NAME=LLNL 26447, RUN 46, X-Y AXIS, 5TH LEVEL/6 BOLTS, OFF-ON FW
TEST DATE=12/05/85 16: 9:46 HOURS

CHANNEL ID	CHANNEL NUMBER	FIRST CHATTER	LAST CHATTER	STATE CHANGE	NUMBER OF CHATTER FAILURES PER TIME LENGTH 2.00-5.00	5.00-10.0	10.0-20.0	20.0-40.0	40.0-80.0	>80.0	TOTAL
1C-NO	2	7.194	14.387	3	1	0	0	0	0	0	1
1C-NC	3	7.991	10.557	3	0	0	1	1	0	0	2
1C-AMPS	4			3	NO CHATTER						
2B-W.NO	6	8.807	14.381	3	1	1	0	0	0	0	2
2B-W.NC	7	8.032	12.018	3	0	2	1	2	0	0	5
2B-X.NO	8	8.804	8.818	3	0	0	1	0	0	0	1
2B-X.NC	10	8.144	12.022	3	0	0	2	4	0	0	6
1G-NO	11			2	NO CHATTER						
1G-NC	12			3	NO CHATTER						
1G-AMPS	13			3	NO CHATTER						
1J-W.NO	14			3	NO CHATTER						
1J-W.NC	15			3	NO CHATTER						
1J-KP.NO	16			3	NO CHATTER						
1J-KP.NC	17			3	NO CHATTER						
1M-NO	18			3	NO CHATTER						
1M-NC	19			3	NO CHATTER						
1M-AMPS	20			3	NO CHATTER						
2E-FW.NO	21			3	NO CHATTER						
2E-FW.NC	22	8.533	12.016	3	0	2	7	0	0	0	9
2E-RV.NO	23			0	NO CHATTER						
2E-RV.NC	24	8.813	12.007	1	0	0	0	0	2	5	7
2E-AMPS	25			3	NO CHATTER						
2J-W.NO	26	14.380	14.382	3	1	0	0	0	0	0	1
2J-W.NC	27			3	NO CHATTER						
2J-GE.NO	28			3	NO CHATTER						
2J-GE.NC	29	8.697	8.707	3	0	1	0	0	0	0	1
2J-KP.NO	30			3	NO CHATTER						
2J-KP.NC	31			3	NO CHATTER						
2J-X.NO	32			3	NO CHATTER						
2J-X.NC	33			3	NO CHATTER						
2J-CH.NO	34			3	NO CHATTER						
2J-CH.NC	35			3	NO CHATTER						
2M-NO	36			2	NO CHATTER						
2M-NC	38	7.982	7.992	2	1	0	0	0	0	0	1
2M-AMPS	39	7.980	14.389	1	0	0	0	0	0	1	1
3B-NO	40	8.810	8.816	3	0	1	0	0	0	0	1
3B-NC	42	8.802	10.551	3	0	0	0	2	0	0	2
3B-AMPS	43			3	NO CHATTER						
3D-GE.NO	44			3	NO CHATTER						

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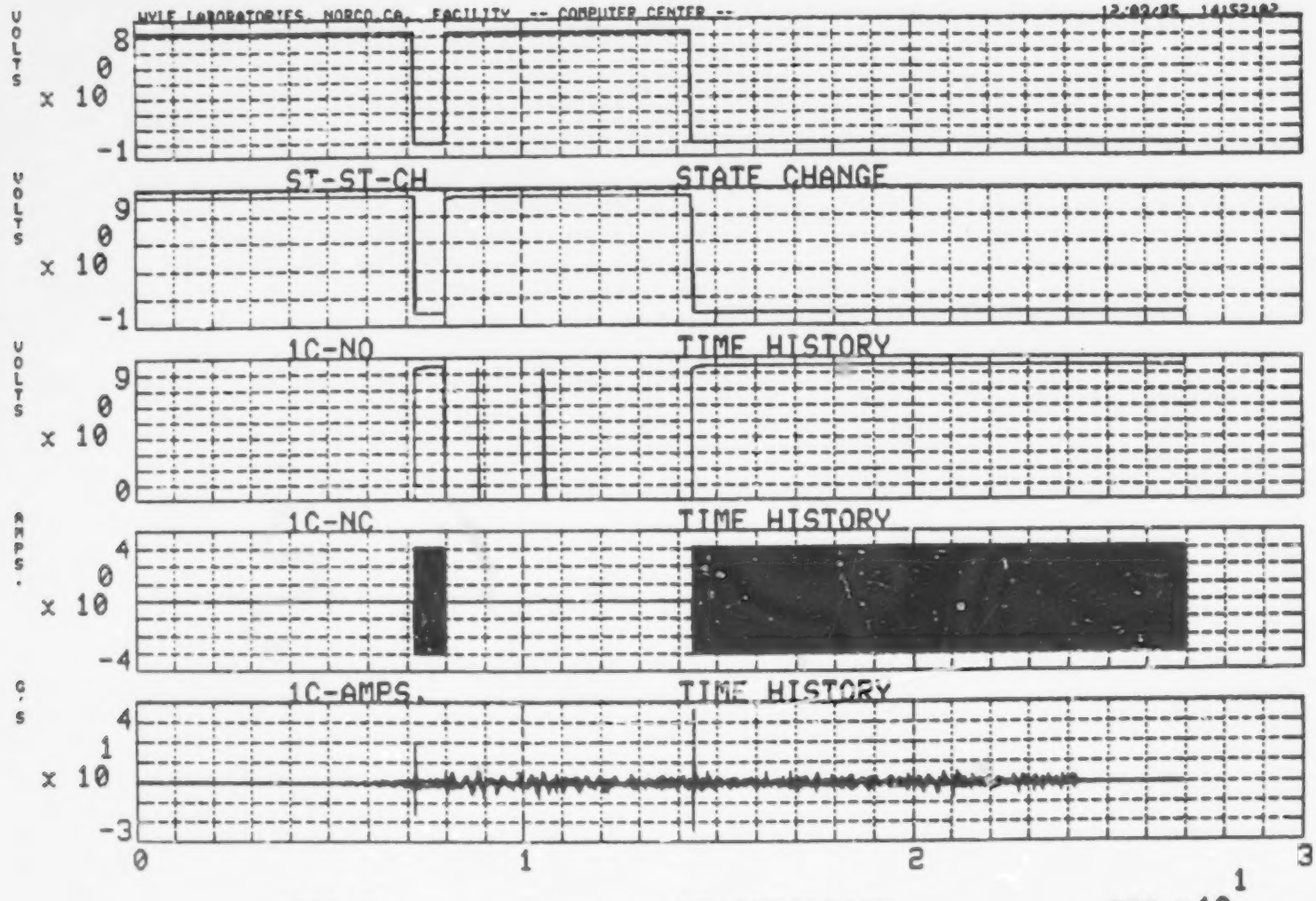
WYLE LABORATORIES,NORCO,CA. FACILITY CHATTER AND PULSE ANALYSIS PROGRAM 12/05/85 16:15:56 HOURS PAGE 2

TEST NAME=LLNL 26447, RUN 46, X-Y AXIS, 5TH LEVEL/6 BOLTS, OFF-ON FW
TEST DATE=12/05/85 16: 9:46 HOURS

CHANNEL ID	CHANNEL NUMBER	FIRST CHATTER	LAST CHATTER	STATE CHANGE	NUMBER OF CHATTER FAILURES PER TIME LENGTH 2.00-5.00	5.00-10.0	10.0-20.0	20.0-40.0	40.0-80.0	>80.0	TOTAL
3D-GE.NC	45			3	NO CHATTER						
3D-CH.NO	46			3	NO CHATTER						
3D-CH.NC	47			3	NO CHATTER						
3D-KP.NO	48			3	NO CHATTER						
3D-KP.NC	49			3	NO CHATTER						
3G-NO	50			2	NO CHATTER						
3G-NC	51			3	NO CHATTER						
3G-AMPS	52	7.980	14.389	1	0	0	0	0	0	1	1
3J-GE1NO	53			3	NO CHATTER						
3J-GE1NC	54			3	NO CHATTER						
3J-GE2NO	55			3	NO CHATTER						
3J-GE2NC	56			3	NO CHATTER						
3M-FW.NO	57			3	NO CHATTER						
3M-FW.NC	58	6.417	14.272	3	4	5	5	0	0	0	14
3M-RV.NO	59			0	NO CHATTER						
3M-RV.NC	60	11.208	13.772	1	0	0	0	0	0	2	2
3M-AMPS	61			3	NO CHATTER						
ST-ST-CH	62			3	STATE SW. # 2 FIRST CHANGE AT 7.1700 LAST CHANGE AT 14.359						
RL-ST-CH	63			3	STATE SW. # 1 FIRST CHANGE AT 7.1570 LAST CHANGE AT 14.366						
RL-OFF	92			3	NO CHATTER						
ST-OFF	94			3	NO CHATTER						
										TOTAL=	57



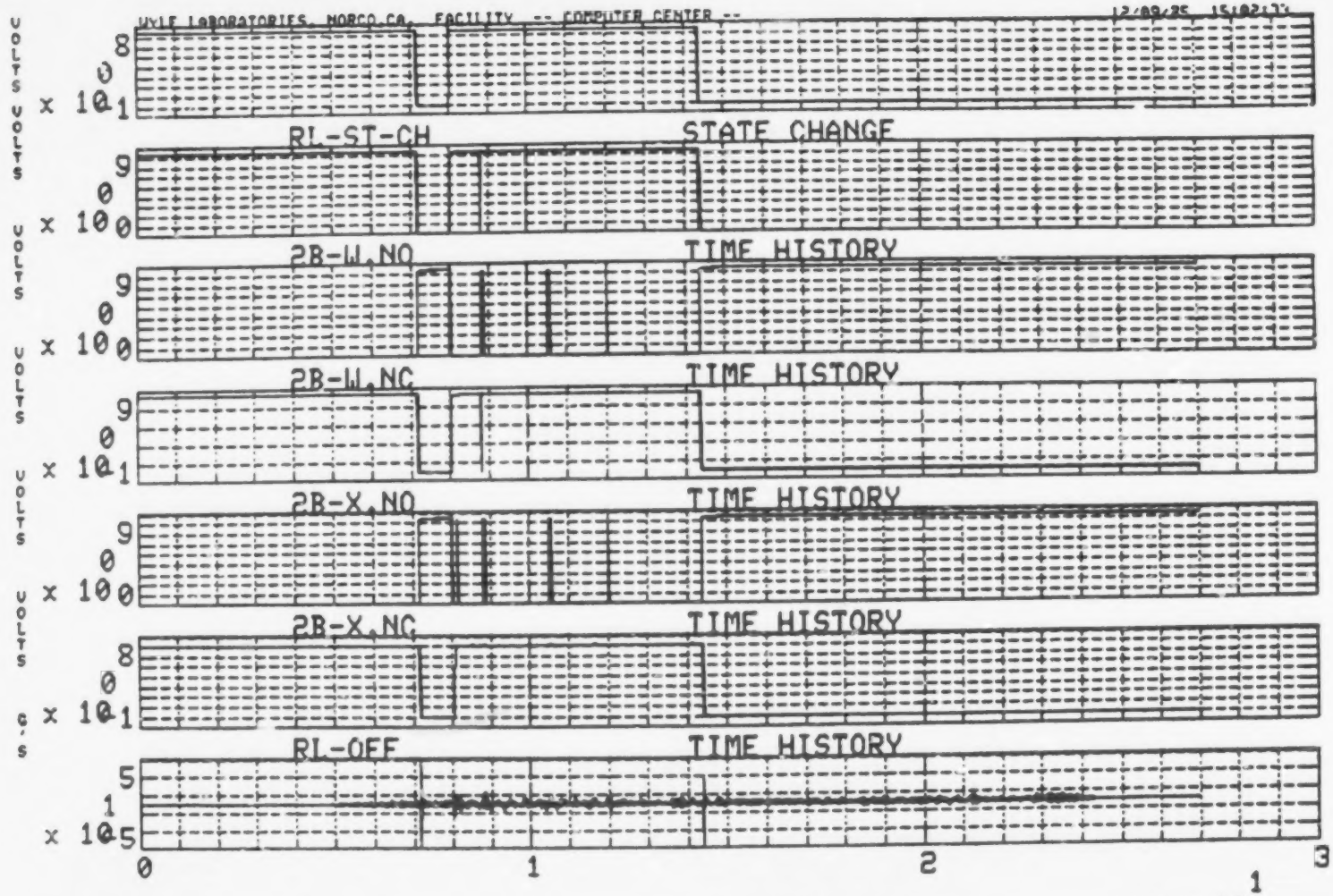
ACC-8 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 12/05/85 DISPLAY NUMBER 1 .00 TO 26.98 SEC

LLNL 26447, RUN 46, X-Y AXIS, 5TH LEVEL/ 6 BOLTS, OFF-ON FW

BEST COPY AVAILABLE



ACC-10 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 12/05/85 DISPLAY NUMBER 2 .00 TO 26.98 SEC

LLNL 26447, RUN 46, X-Y AXIS, 5TH LEVEL/ 6 BOLTS, OFF-ON FW

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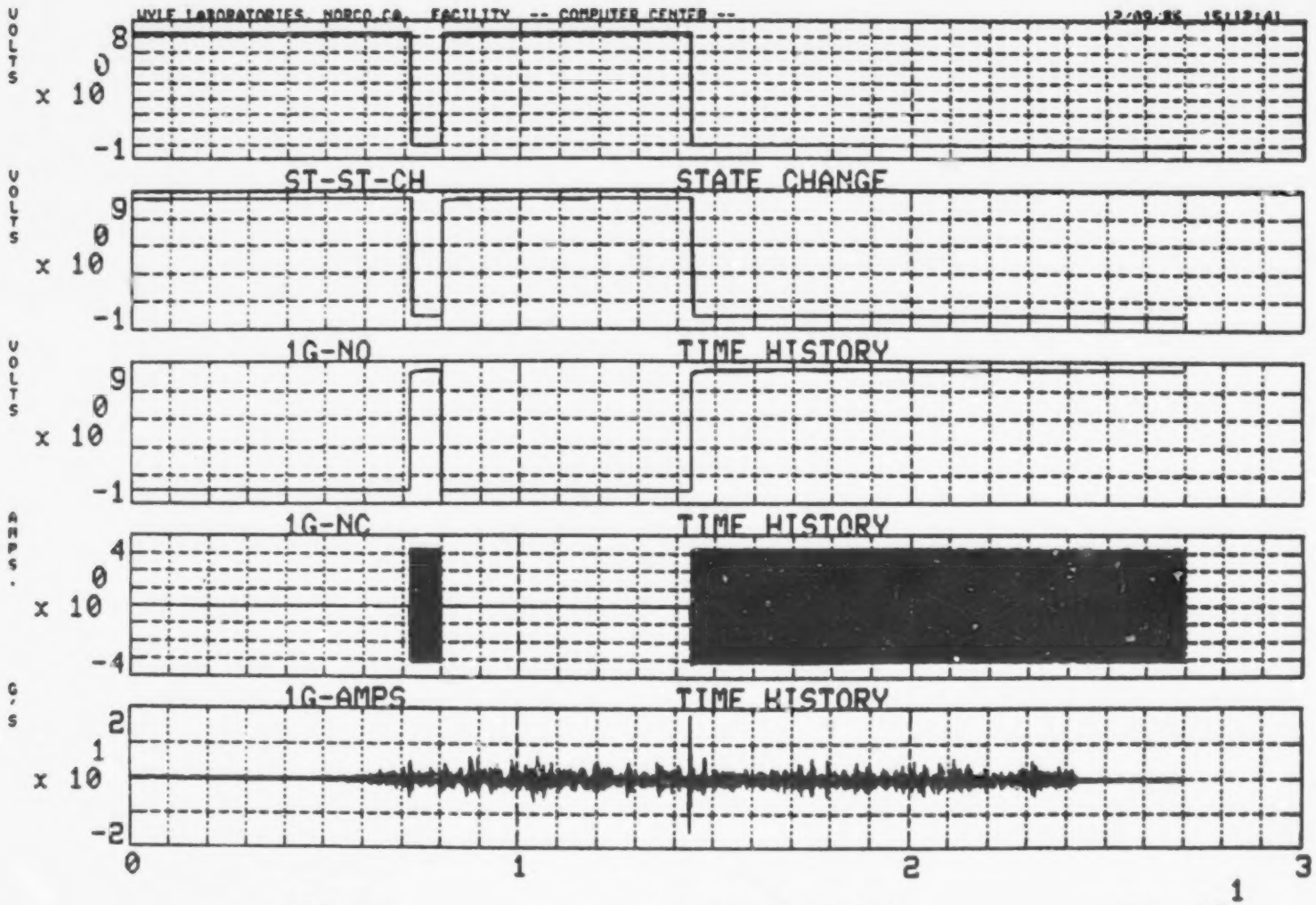


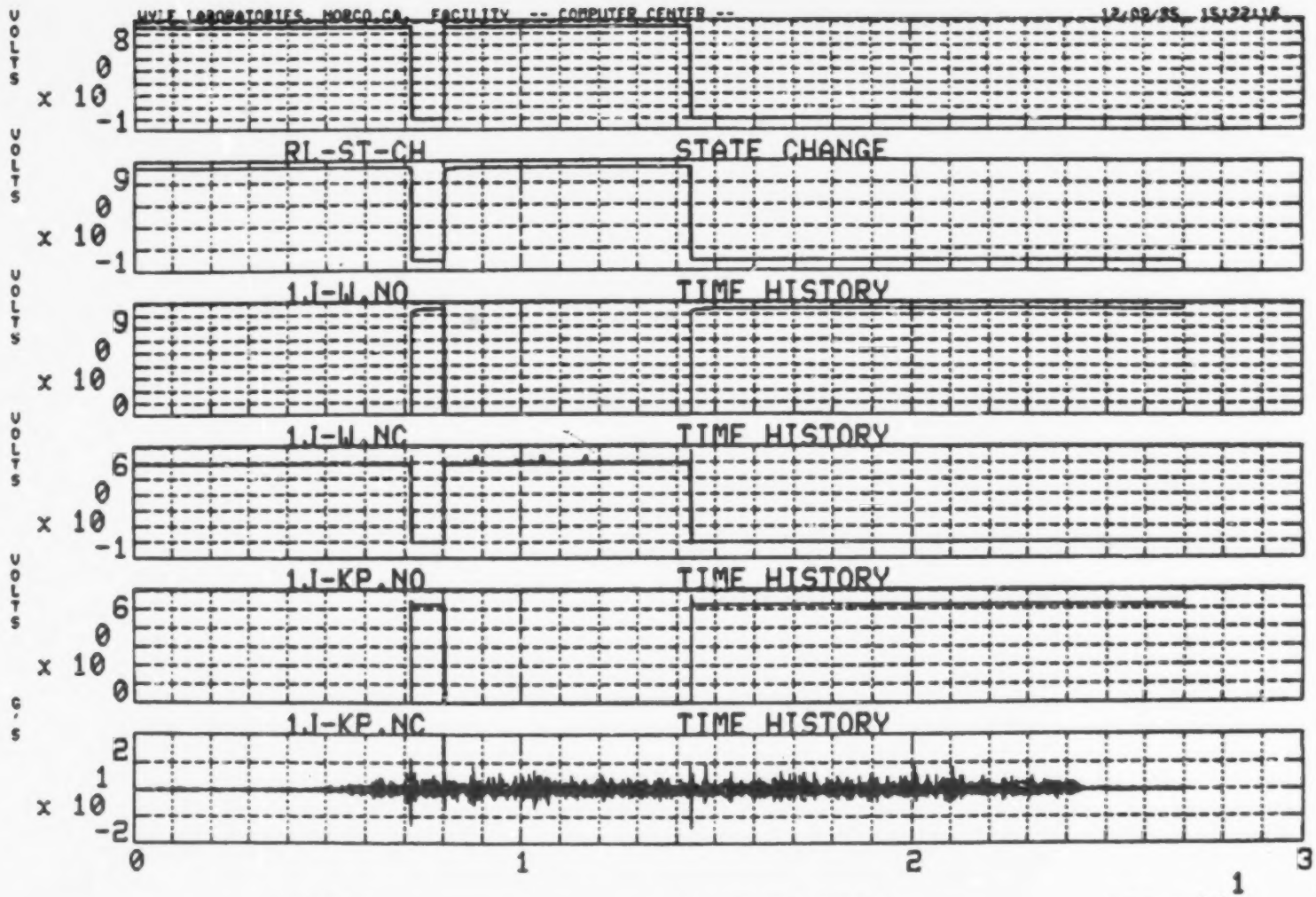
ACC-14 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 12/05/85 DISPLAY NUMBER 3 .00 TO 26.98 SEC

LLNL 26447, RUN 46, X-Y AXIS, 5TH LEVEL/ 6 BOLTS, OFF-ON FW

BEST COPY AVAILABLE



ACC-3 ACCELERATION SEC x 10

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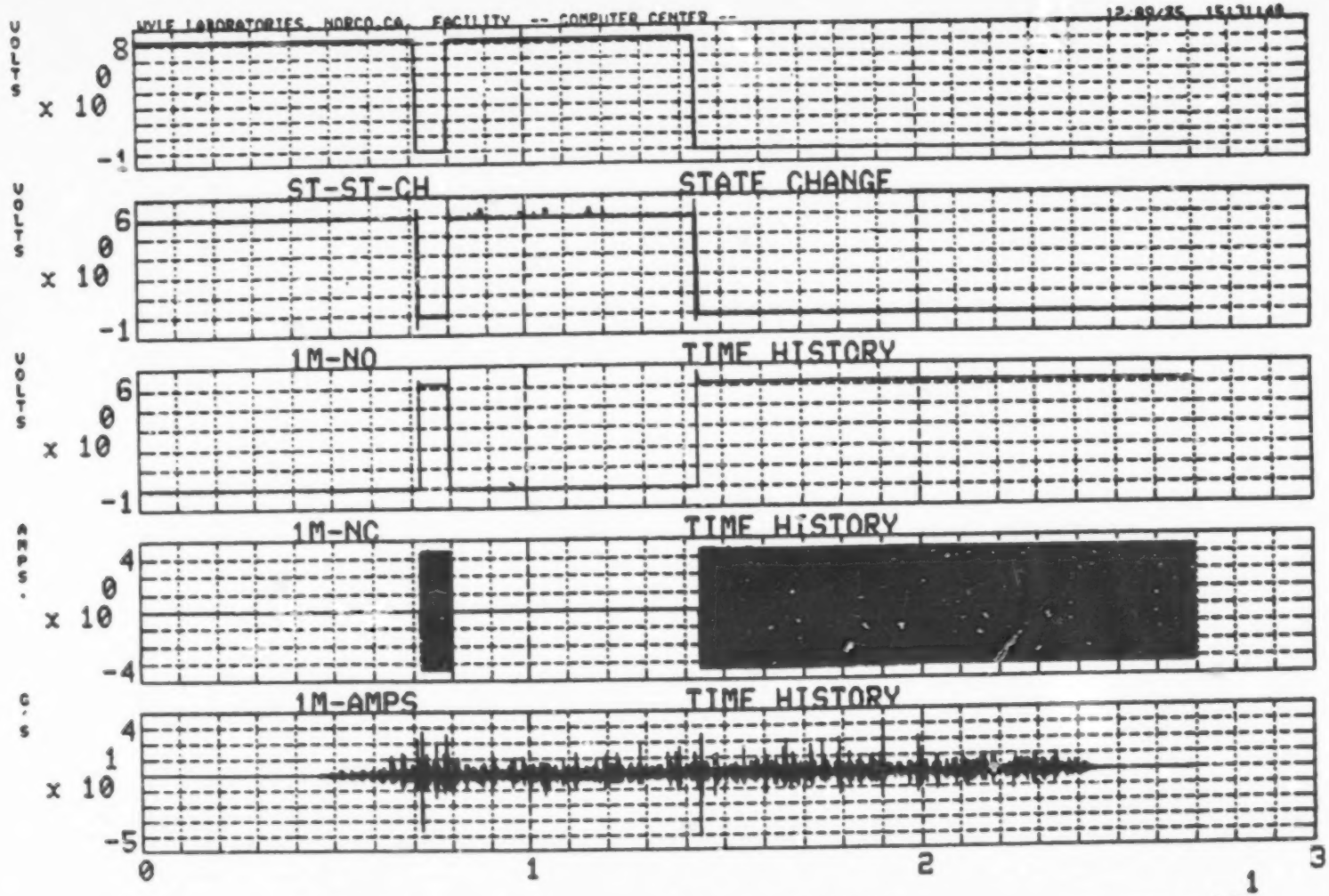
DATE 12/05/85 DISPLAY NUMBER 4 .00 TO 26.98 SEC

LLNL 26447, RUN 46, X-Y AXIS, 5TH LEVEL/ 6 BOLTS, OFF-ON FW

BEST COPY AVAILABLE



ACC-18 ACCELERATION

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DATE 12/05/85 DISPLAY NUMBER 5 .00 TO 26.98 SEC

LLNL 26447, RUN 46, X-Y AXIS, 5TH LEVEL/ 6 BOLTS, OFF-ON FW

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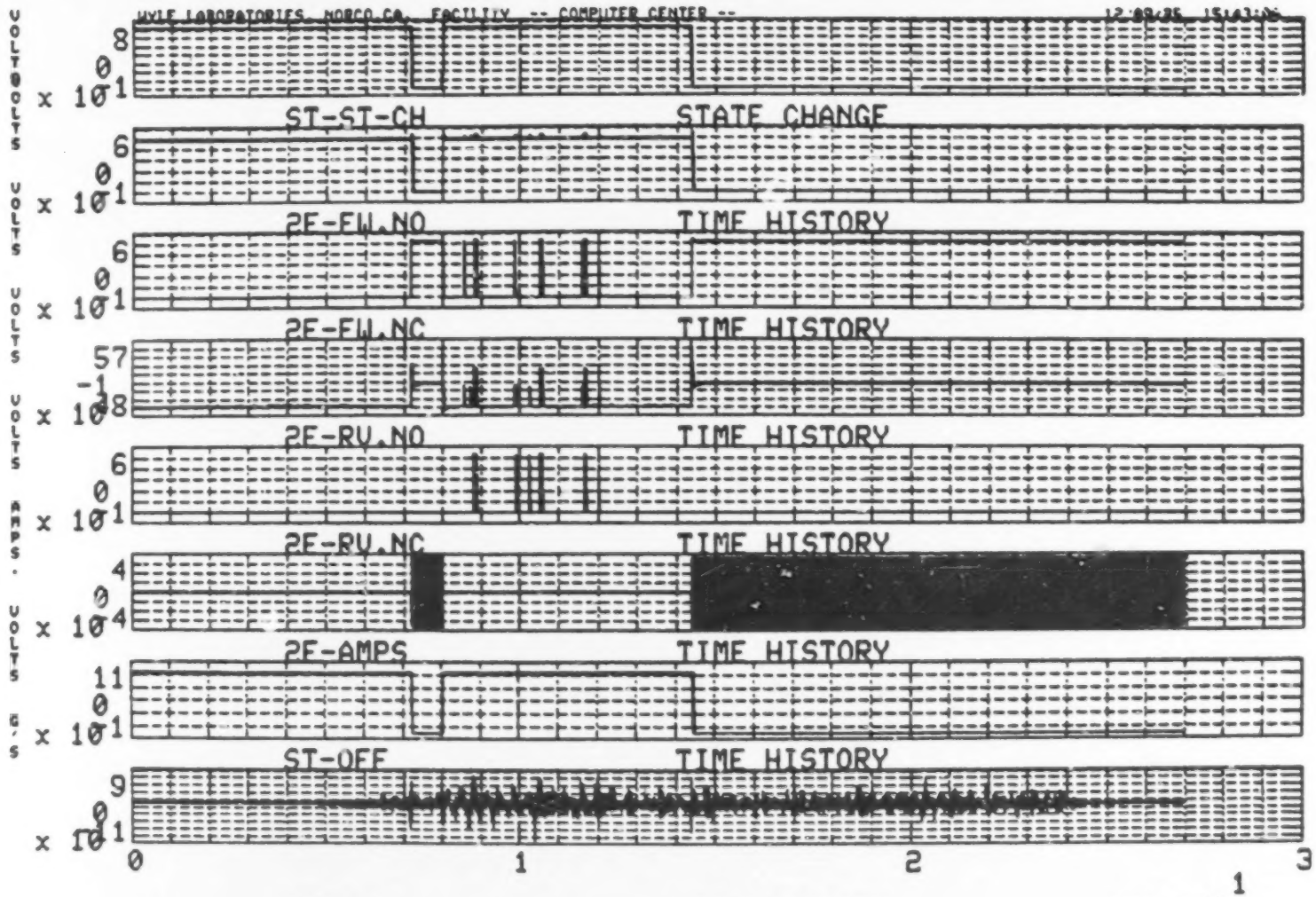


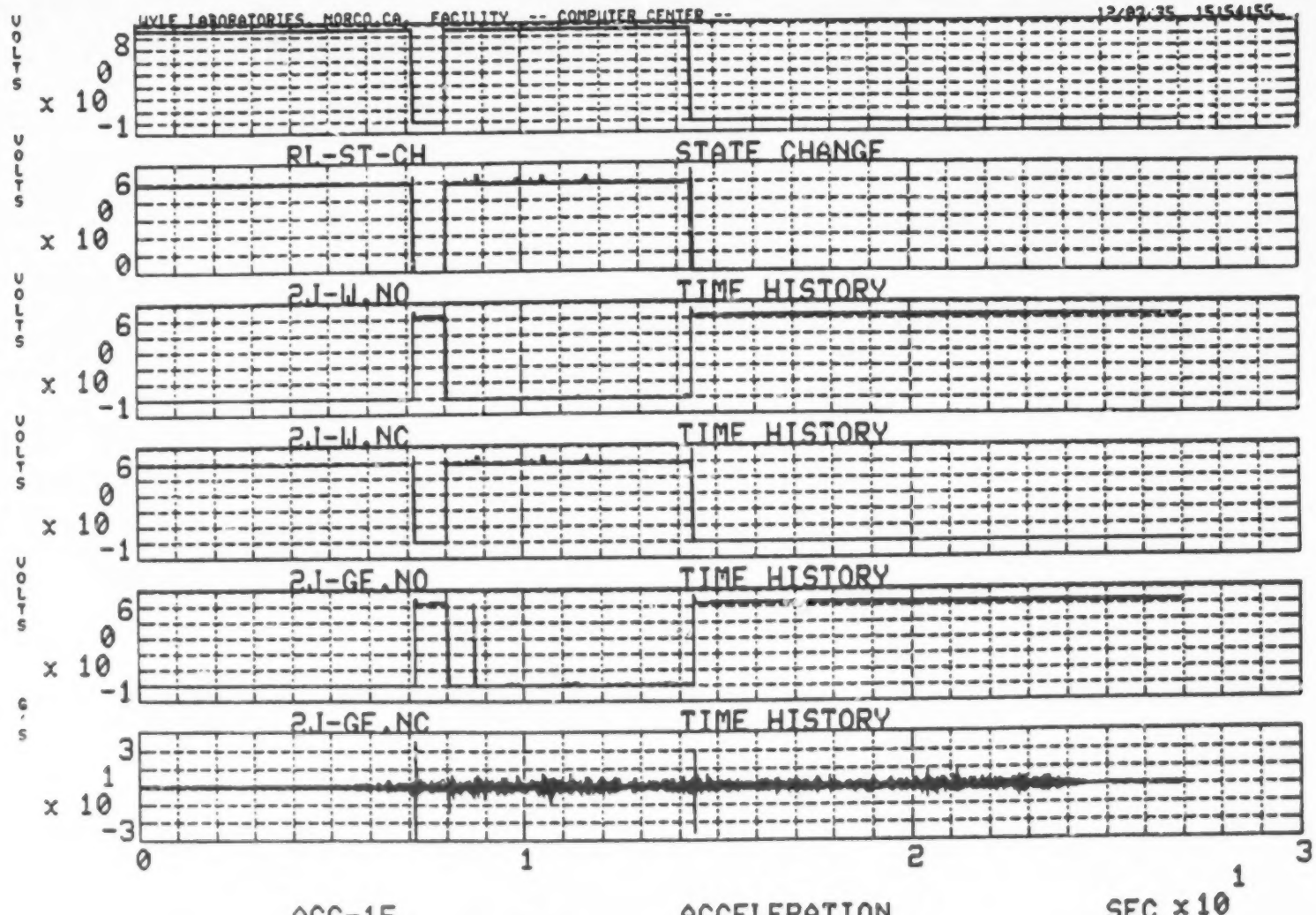
ACC-11 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 12/05/85 DISPLAY NUMBER 6 .00 TO 26.98 SEC

LLNL 26447, RUN 46, X-Y AXIS, 5TH LEVEL/ 6 BOLTS, OFF-ON FW

BEST COPY AVAILABLE



ACC-15 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 12/05/85 DISPLAY NUMBER 7 .00 TO 26.98 SEC

LLNL 26447, RUN 46, X-Y AXIS, 5TH LEVEL/ 6 BOLTS, OFF-ON FW

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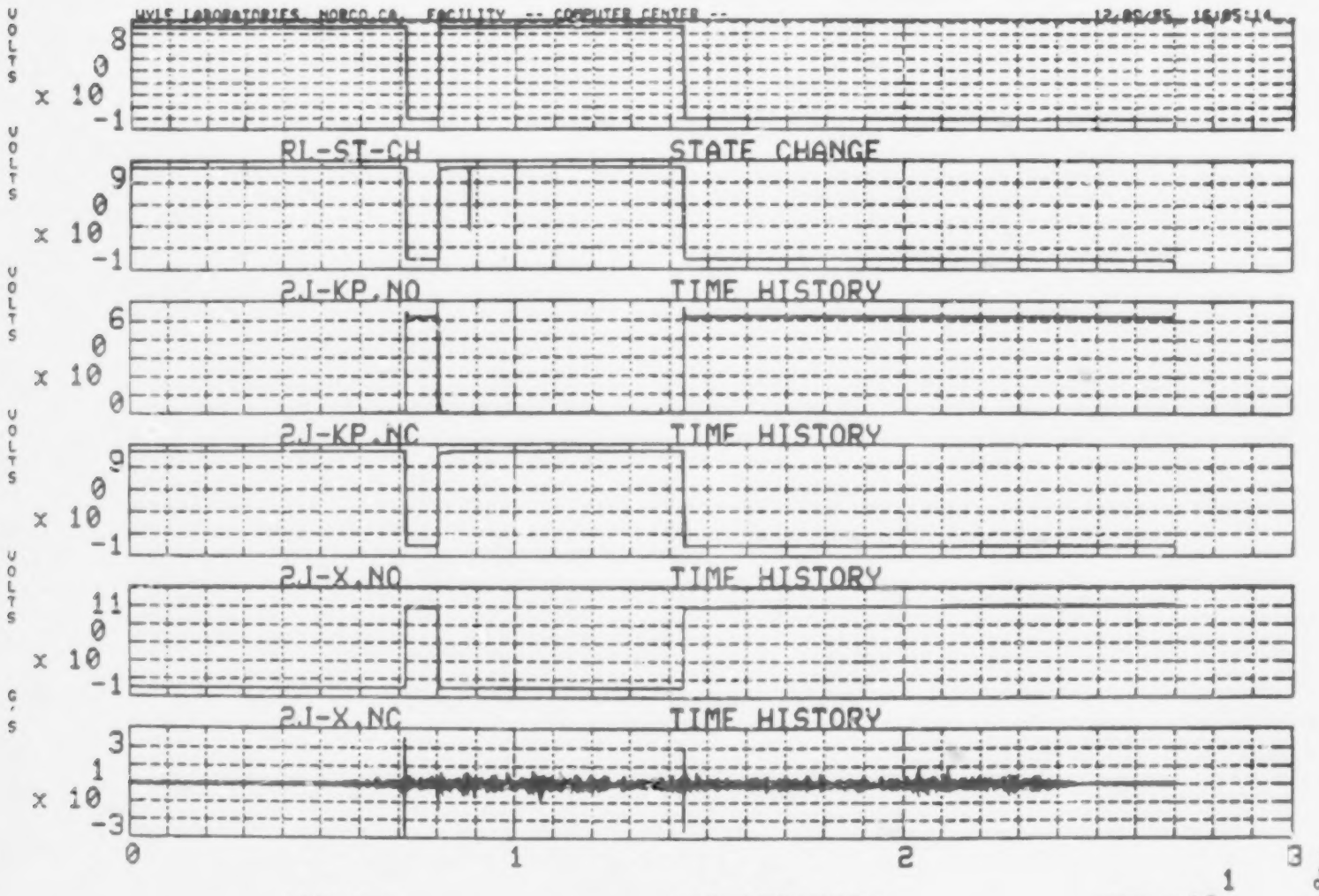

ACC-15 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 12/05/85 DISPLAY NUMBER 8 .00 TO 26.98 SEC

LLNL 26447, RUN 46, X-Y AXIS, 5TH LEVEL/ 6 BOLTS, OFF-ON FW

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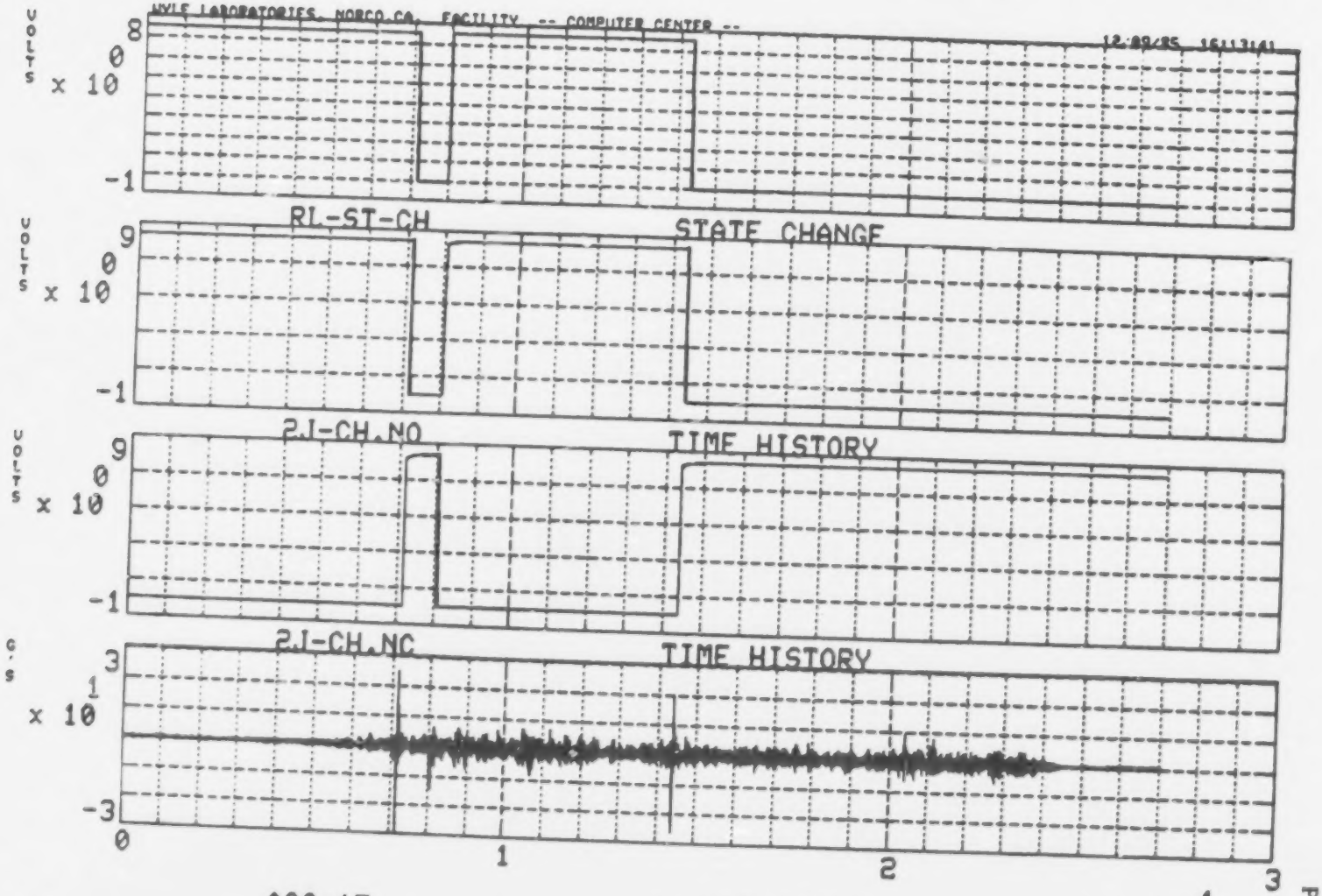

ACC-15

ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 12/05/85 DISPLAY NUMBER 9 .00 TO 26.98 SEC

LLNL 26447, RUN 46, X-Y AXIS, 5TH LEVEL/ 6 BOLTS, OFF-ON FW

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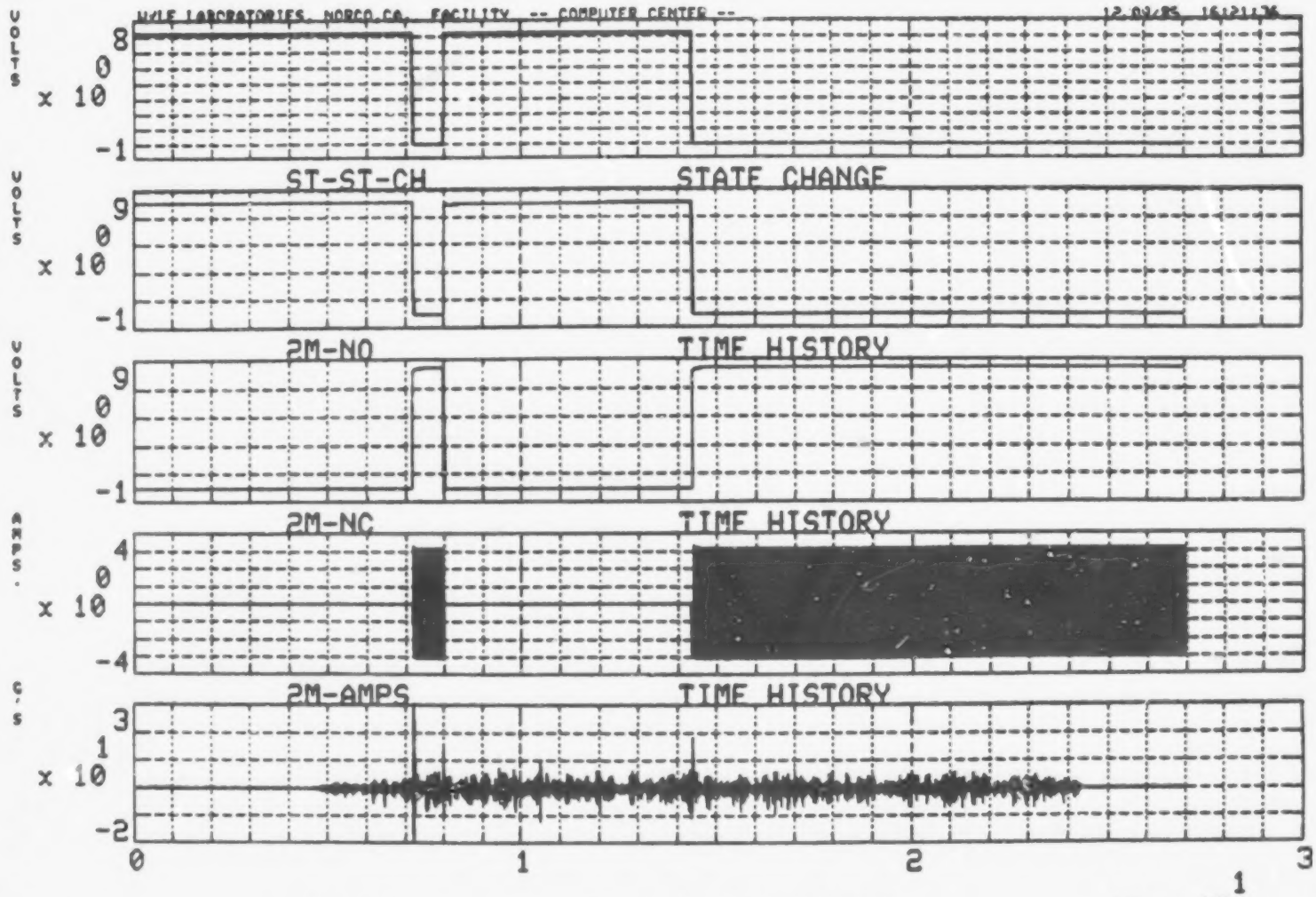


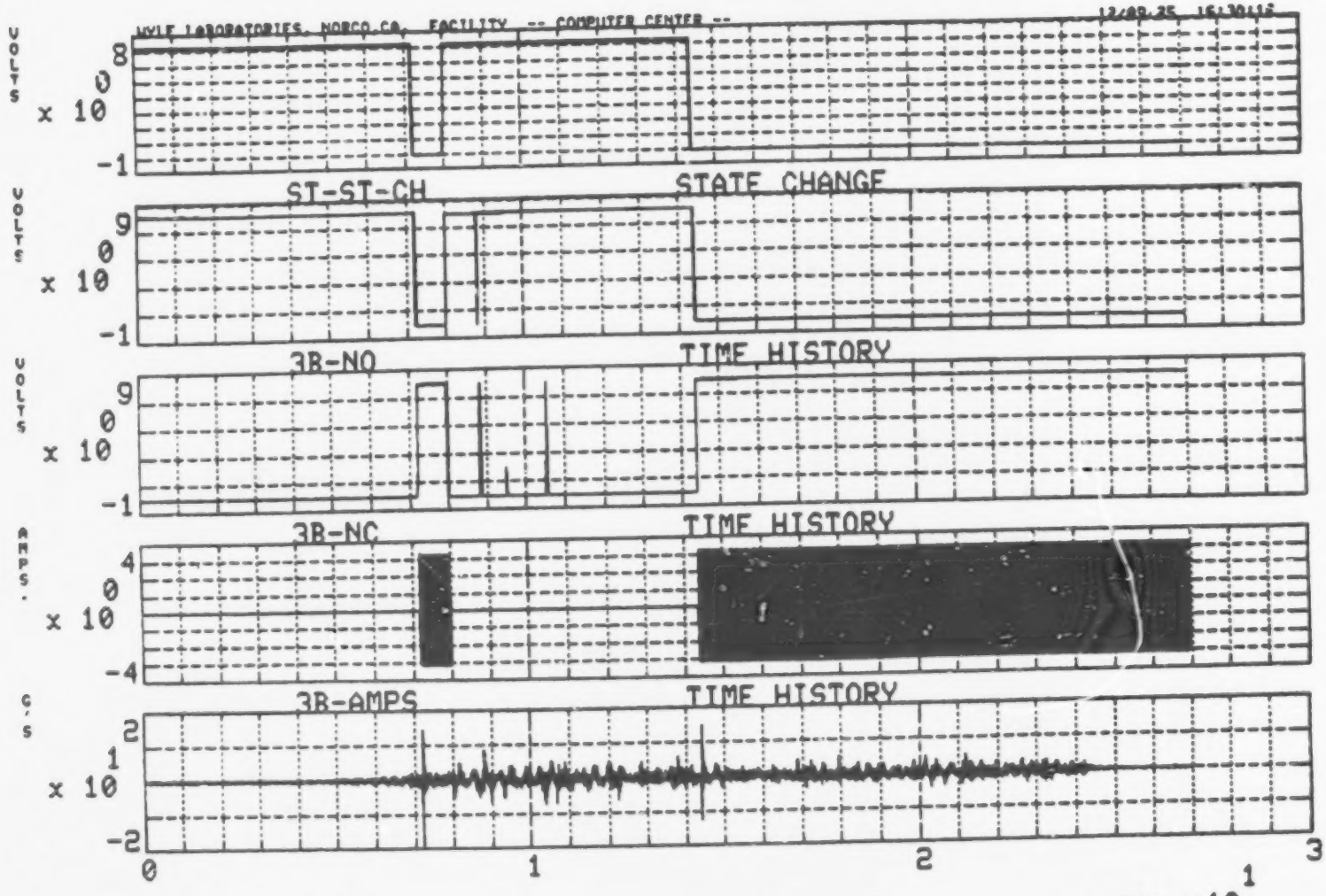
ACC-4 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 12/05/85 DISPLAY NUMBER 10 .00 TO 26.98 SEC

LLNL 26447, RUN 46, X-Y AXIS, 5TH LEVEL/ 6 BOLTS, OFF-ON FW

BEST COPY AVAILABLE



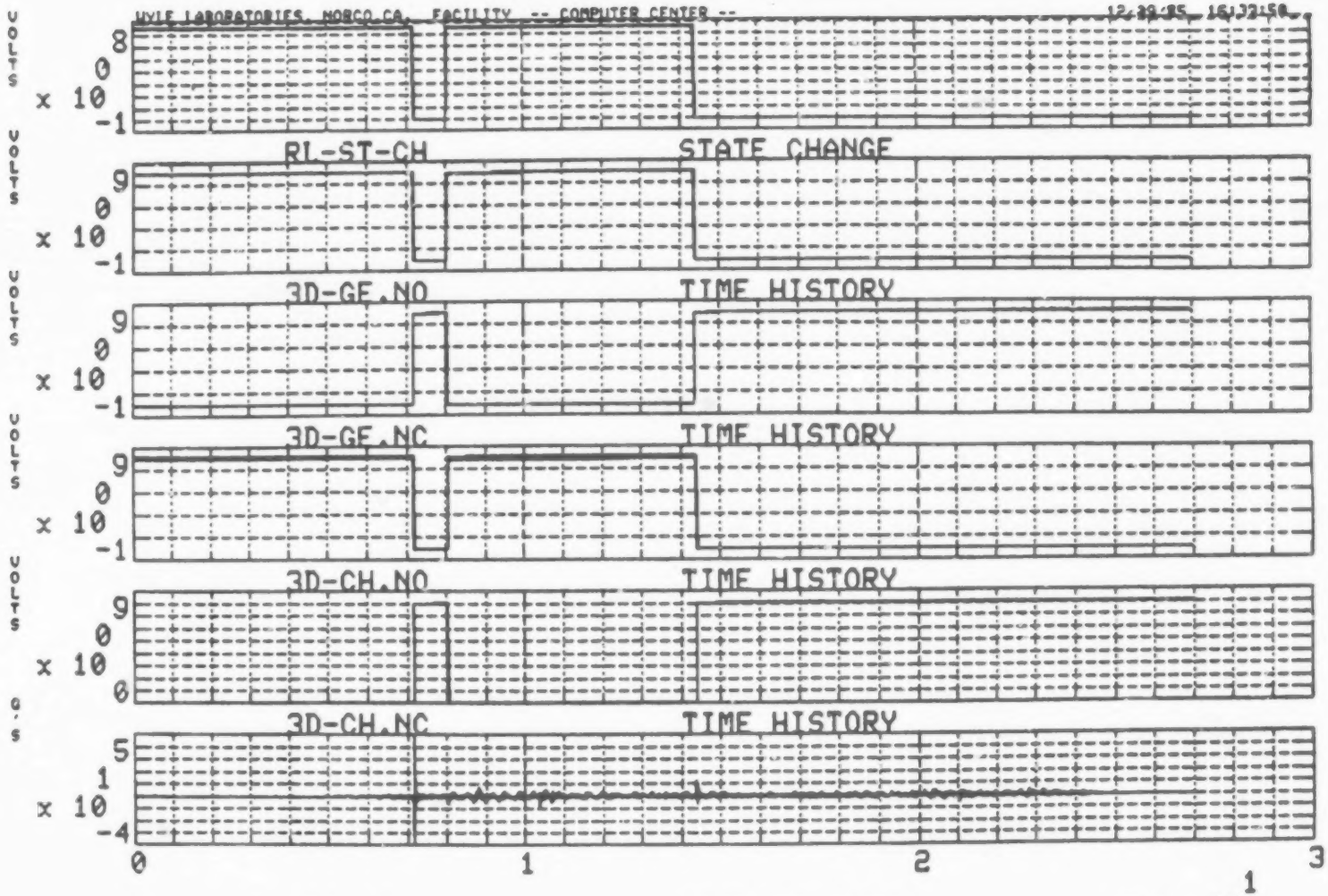
ACC-9 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 12/05/85 DISPLAY NUMBER 11 .00 TO 26.98 SEC

LLNL 26447, RUN 46, X-Y AXIS, 5TH LEVEL/ 6 BOLTS, OFF-ON FW

BEST COPY AVAILABLE



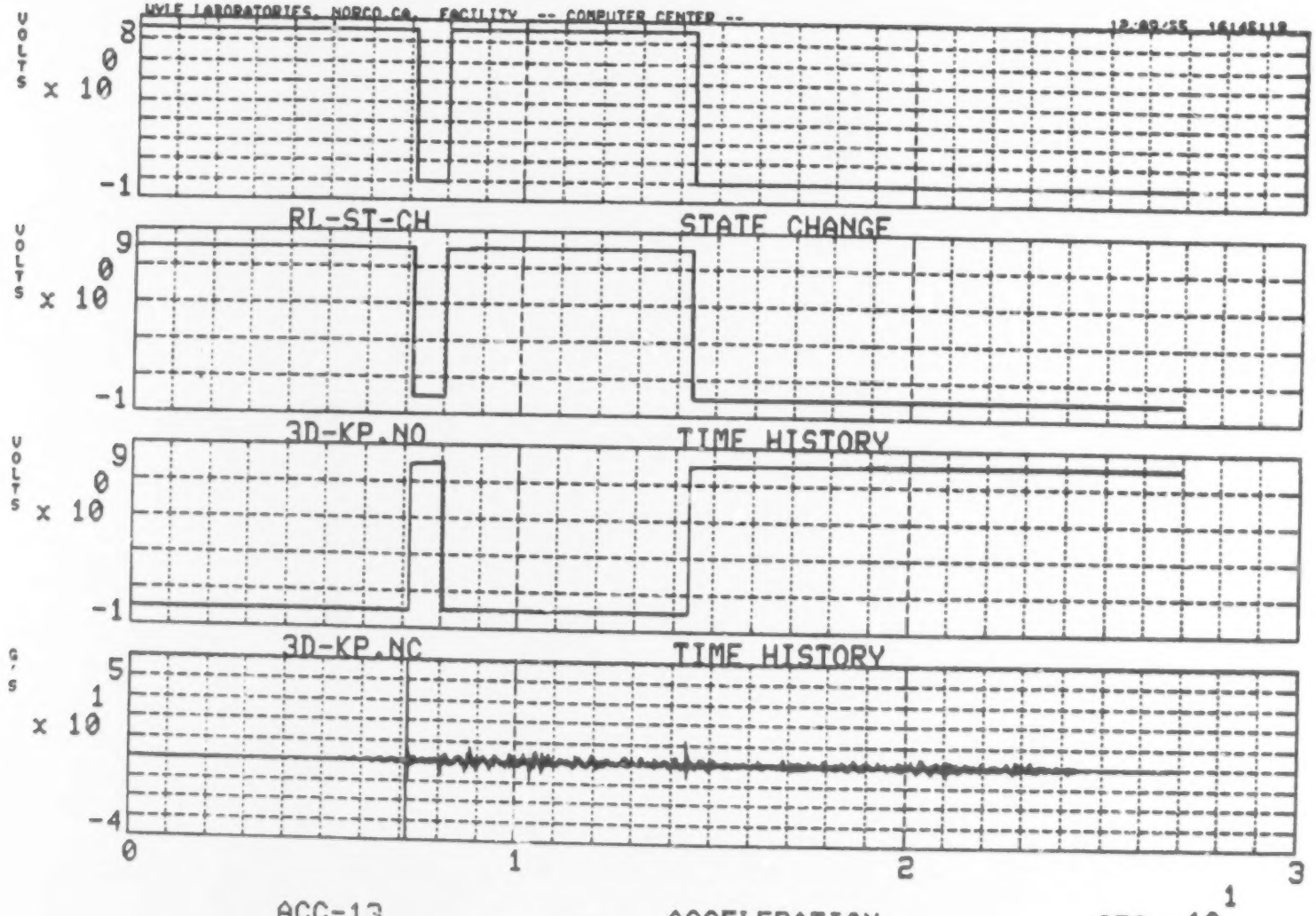
ACC-13 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 12/05/85 DISPLAY NUMBER 12 .00 TO 26.98 SEC

LLNL 26447, RUN 46, X-Y AXIS, 5TH LEVEL/ 6 BOLTS, OFF-ON FW

BEST COPY AVAILABLE



ACC-13 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 12/05/85 DISPLAY NUMBER 13 .00 TO 26.98 SEC

LLNL 26447, RUN 46, X-Y AXIS, 5TH LEVEL/ 6 BOLTS, OFF-ON FW

Report No. 26448

Page No. B-499

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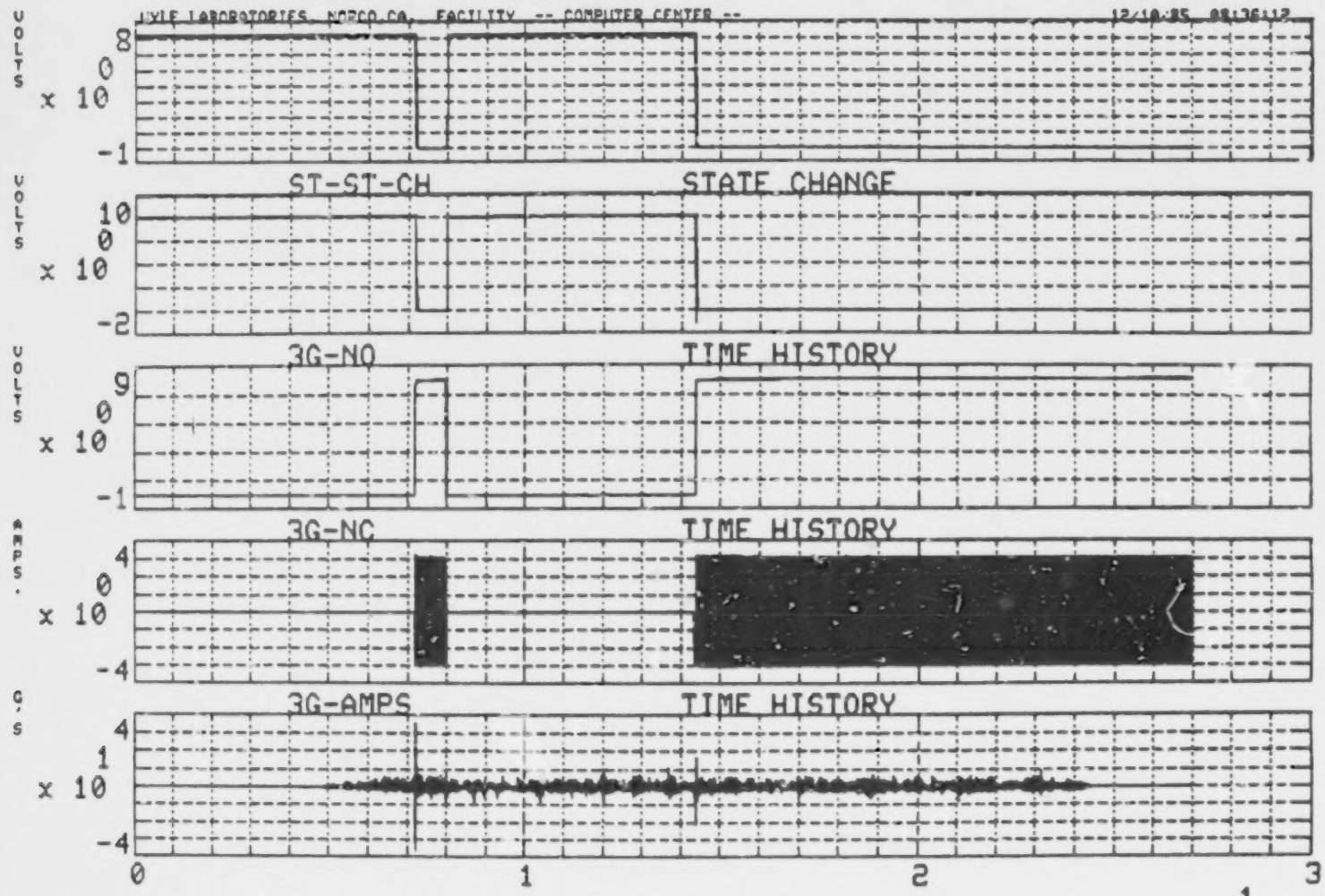

ACC-16 ACCELERATION

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DATE 12/05/85 DISPLAY NUMBER 14 .00 TO 26.98 SEC

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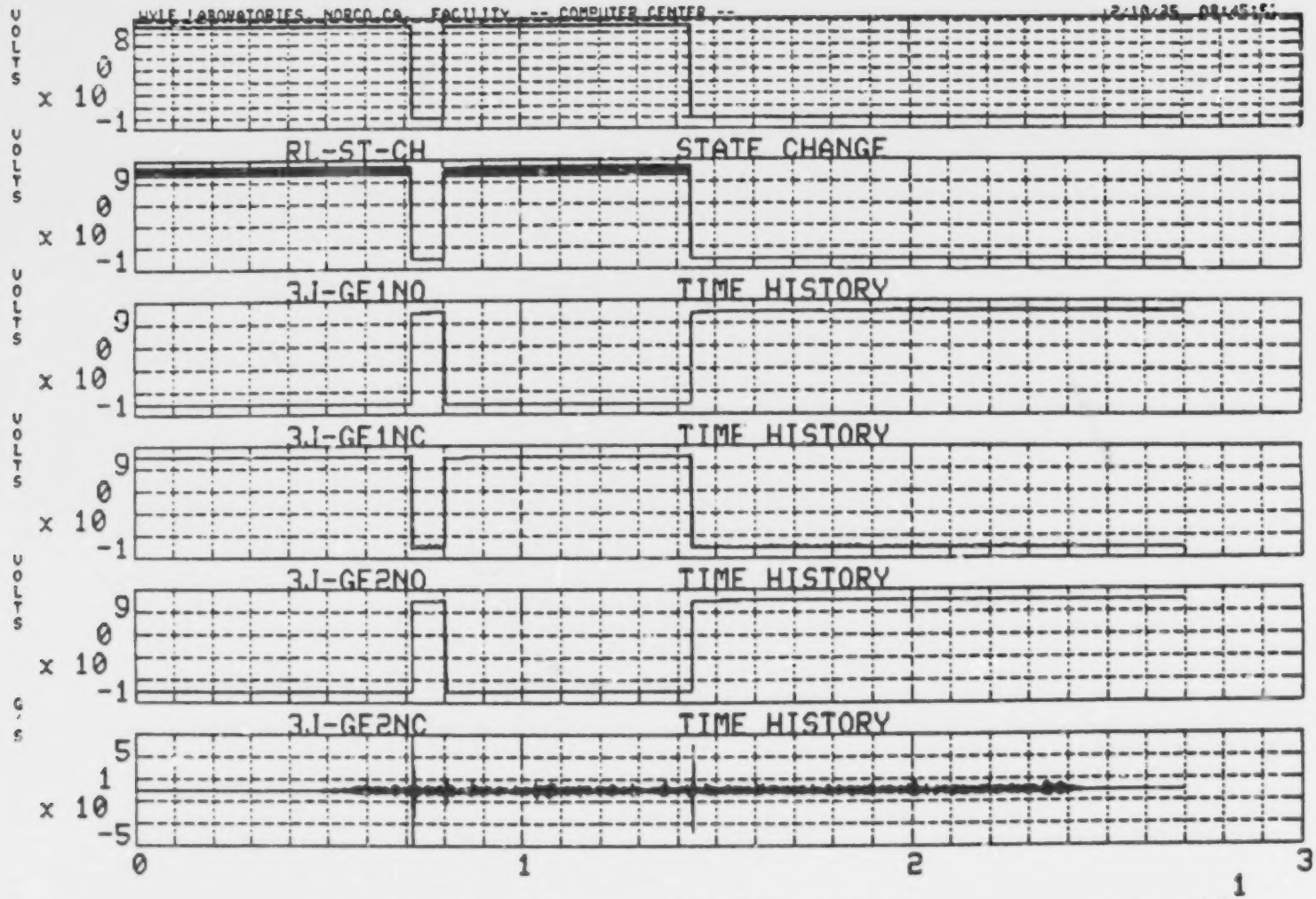
BEST COPY AVAILABLE



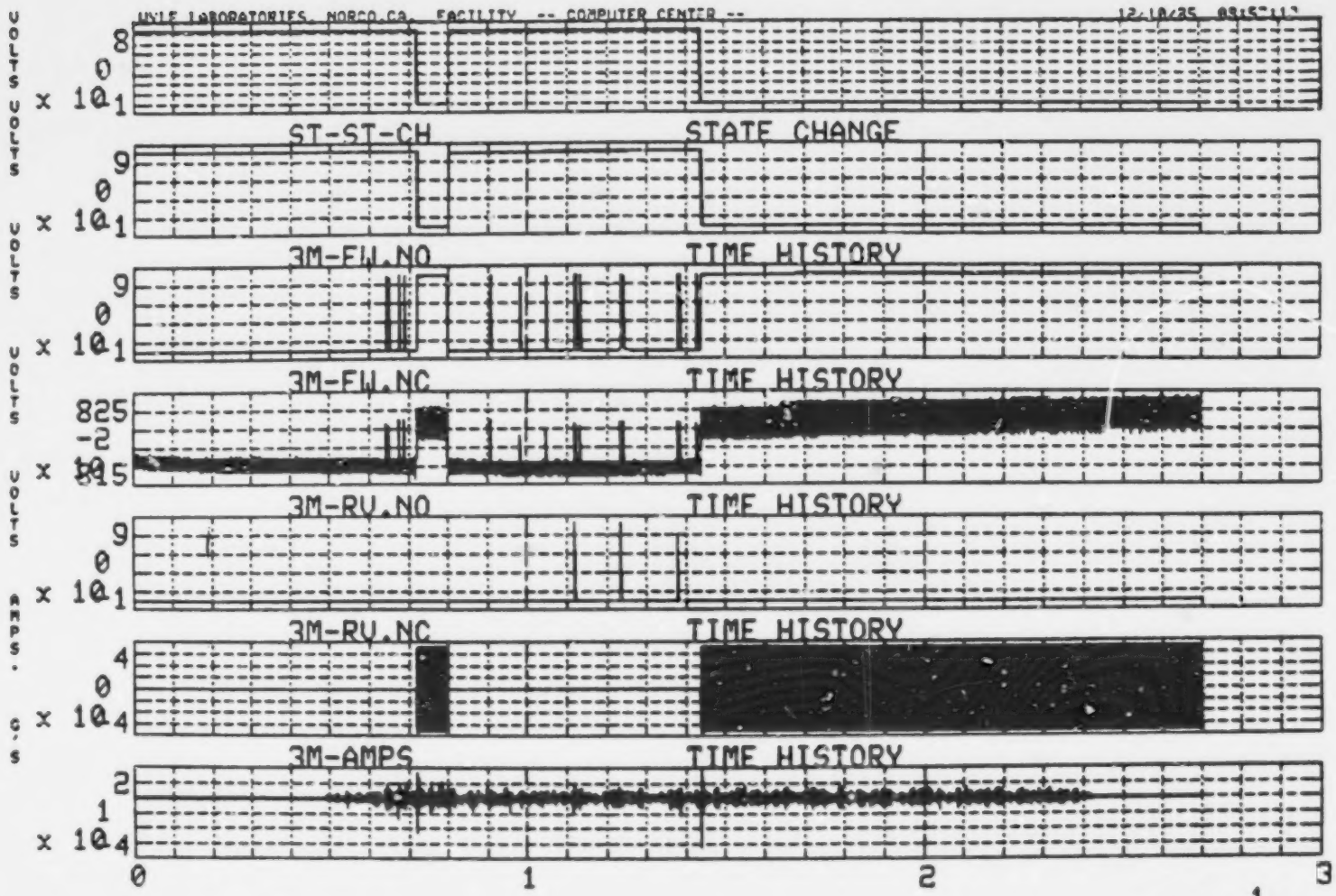
ACC-17 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 12/05/85 DISPLAY NUMBER 15 .00 TO 26.98 SEC

LLNL 26447, RUN 46, X-Y AXIS, 5TH LEVEL/ 6 BOLTS, OFF-ON FW

BEST COPY AVAILABLE



ACC-19 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 12/05/85 DISPLAY NUMBER 16 .00 TO 26.98 SEC

LLNL 26447, RUN 46, X-Y AXIS, 5TH LEVEL/ 6 BOLTS, OFF-ON FW

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RUN 56

Four bolts per column with internal bracing, 2.2g table ZPA

START TIME= 0.0000 STOP TIME= 26.341

TEST NAME=LLNL 26447,RUN 56,X-Y,5TH LEVEL/12 BOLTS/CAB.MOD, ON-OFF RV
TEST DATE=12/11/85 16:17:52 HOURS

CHANNEL ID	CHANNEL NUMBER	FIRST CHATTER	LAST CHATTER	STATE CHANGE	NUMBER OF CHATTER FAILURES PER TIME LENGTH 2.00-5.00	5.00-10.0	10.0-20.0	20.0-40.0	40.0-80.0	>80.0	TOTAL
1C-NO	2	14.229	23.164	1	0	0	0	0	0	2	2
1C-NC	3	19.482	22.184	1	1	0	0	3	0	0	4
1C-AMPS	4			0	NO CHATTER						
2B-W.NO	6	21.942	21.954	1	0	0	1	0	0	0	1
2B-W.NC	7	14.250	22.167	1	0	1	1	1	0	0	3
2B-X.NO	8	21.949	22.151	1	1	1	0	0	0	0	2
2B-X.NC	10	19.460	23.007	1	2	1	0	3	0	0	6
1G-NO	11			0	NO CHATTER						
1G-NC	12	19.481	21.956	1	0	1	0	1	0	0	2
1G-AMPS	13			0	NO CHATTER						
1J-W.NO	14			1	NO CHATTER						
1J-W.NC	15			1	NO CHATTER						
1J-KP.NO	16			1	NO CHATTER						
1J-KP.NC	17			1	NO CHATTER						
1M-NO	18			1	NO CHATTER						
1M-NC	19			1	NO CHATTER						
1M-AMPS	20			1	NO CHATTER						
2E-FW.NO	21			0	NO CHATTER						
2E-FW.NC	22	14.277	22.131	1	0	0	0	0	1	2	3
2E-RV.NO	23			1	NO CHATTER						
2E-RV.NC	24	14.324	23.012	1	0	7	3	1	0	0	11
2E-AMPS	25			0	NO CHATTER						
2J-W.NO	26			1	NO CHATTER						
2J-W.NC	27			1	NO CHATTER						
2J-GE.NO	28			1	NO CHATTER						
2J-GE.NC	29	22.048	22.059	1	0	0	1	0	0	0	1
2J-KP.NO	30			1	NO CHATTER						
2J-KP.NC	31			1	NO CHATTER						
2J-X.NO	32			1	NO CHATTER						
2J-X.NC	33	19.491	22.132	1	0	0	1	0	0	0	1
2J-CH.NO	34			1	NO CHATTER						
2J-CH.NC	35			1	NO CHATTER						
2M-NO	36			1	NO CHATTER						
2M-NC	38			1	NO CHATTER						
2M-AMPS	39			0	NO CHATTER						
3B-NO	40	14.229	22.144	1	0	0	0	0	0	2	2
3B-NC	42	14.288	23.008	1	0	3	3	2	0	0	8
3B-AMPS	43			0	NO CHATTER						
3D-GE.NO	44			1	NO CHATTER						

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WYLE LABORATORIES,NORCO,CA. FACILITY CHATTER AND PULSE ANALYSIS PROGRAM 12/16/85 09:05:56 HOURS PAGE 2

TEST NAME=LLNL 26447,RUN 56,X-Y,5TH LEVEL/12 BOLTS/CAB.MOD, ON-OFF RV
TEST DATE=12/11/85 16:17:52 HOURS

CHANNEL ID	CHANNEL NUMBER	FIRST CHATTER	LAST CHATTER	STATE CHANGE	NUMBER OF CHATTER FAILURES PER TIME LENGTH 2.00-5.00	5.00-10.0	10.0-20.0	20.0-40.0	40.0-80.0	>80.0	TOTAL
3D-GE.NC	45			1	NO CHATTER						
3D-CH.NO	46			1	NO CHATTER						
3D-CH.NC	47			1	NO CHATTER						
3D-KP.NO	48			1	NO CHATTER						
3D-KP.NC	49			1	NO CHATTER						
3G-NO	50			1	NO CHATTER						
3G-NC	51			1	NO CHATTER						
3G-AMPS	52			0	NO CHATTER						
3J-GE1NO	53			1	NO CHATTER						
3J-GE1NC	54			1	NO CHATTER						
3J-GE2NO	55			1	NO CHATTER						
3J-GE2NC	56			1	NO CHATTER						
3M-FW.NO	57			0	NO CHATTER						
3M-FW.NC	58	14.326	22.534	1	1	0	0	0	3	14	18
3M-RV.NO	59			1	NO CHATTER						
3M-RV.NC	60	19.223	21.697	1	1	2	1	0	0	0	4
3M-AMPS	61			1	NO CHATTER						
ST-ST-CH	62			1	STATE SW. # 2	CHANGE AT 14.229					
RL-ST-CH	63			1	STATE SW. # 1	CHANGE AT 14.226					
RL-OFF	92			1	NO CHATTER						
ST-OFF	94			1	NO CHATTER						
										TOTAL=	68

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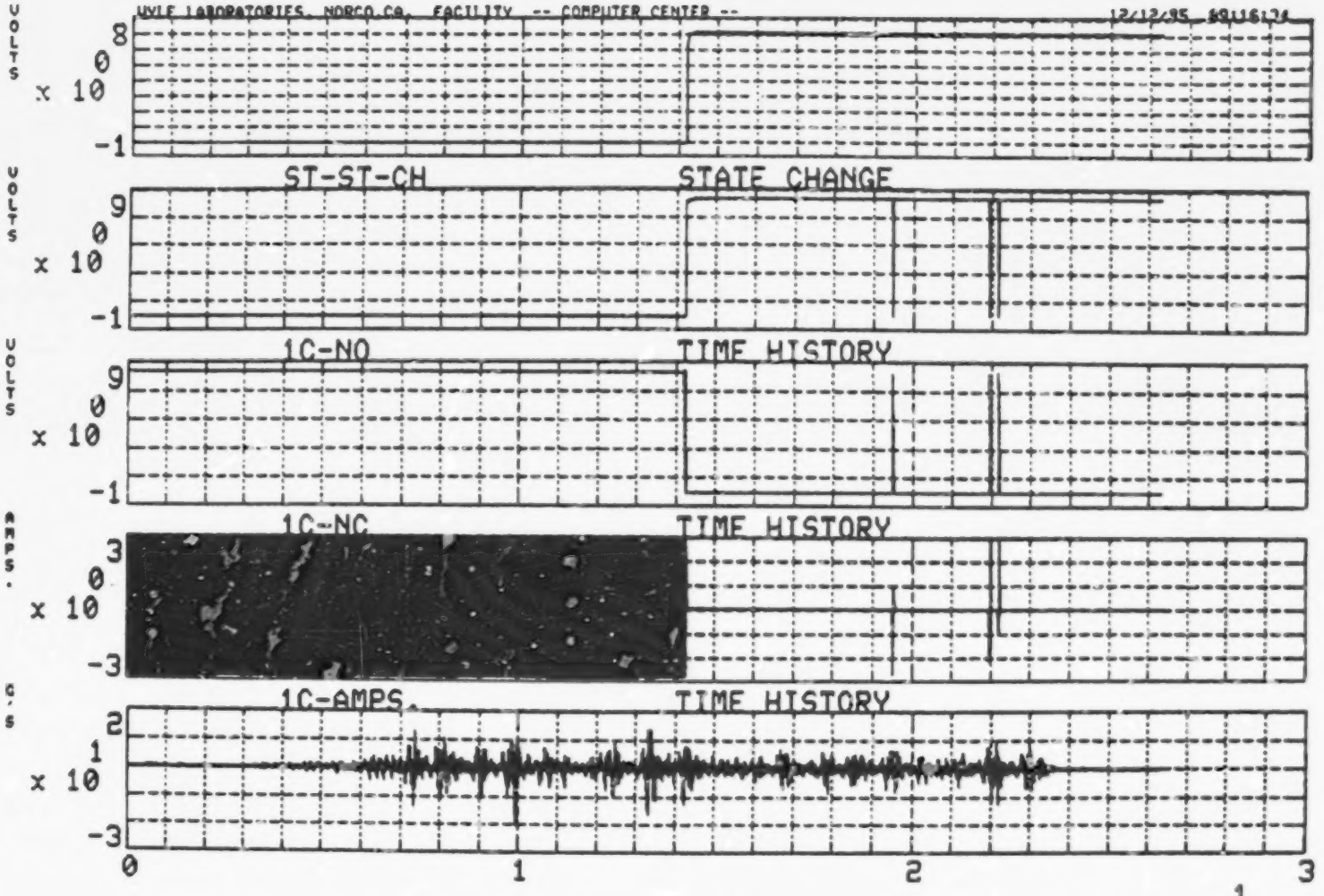


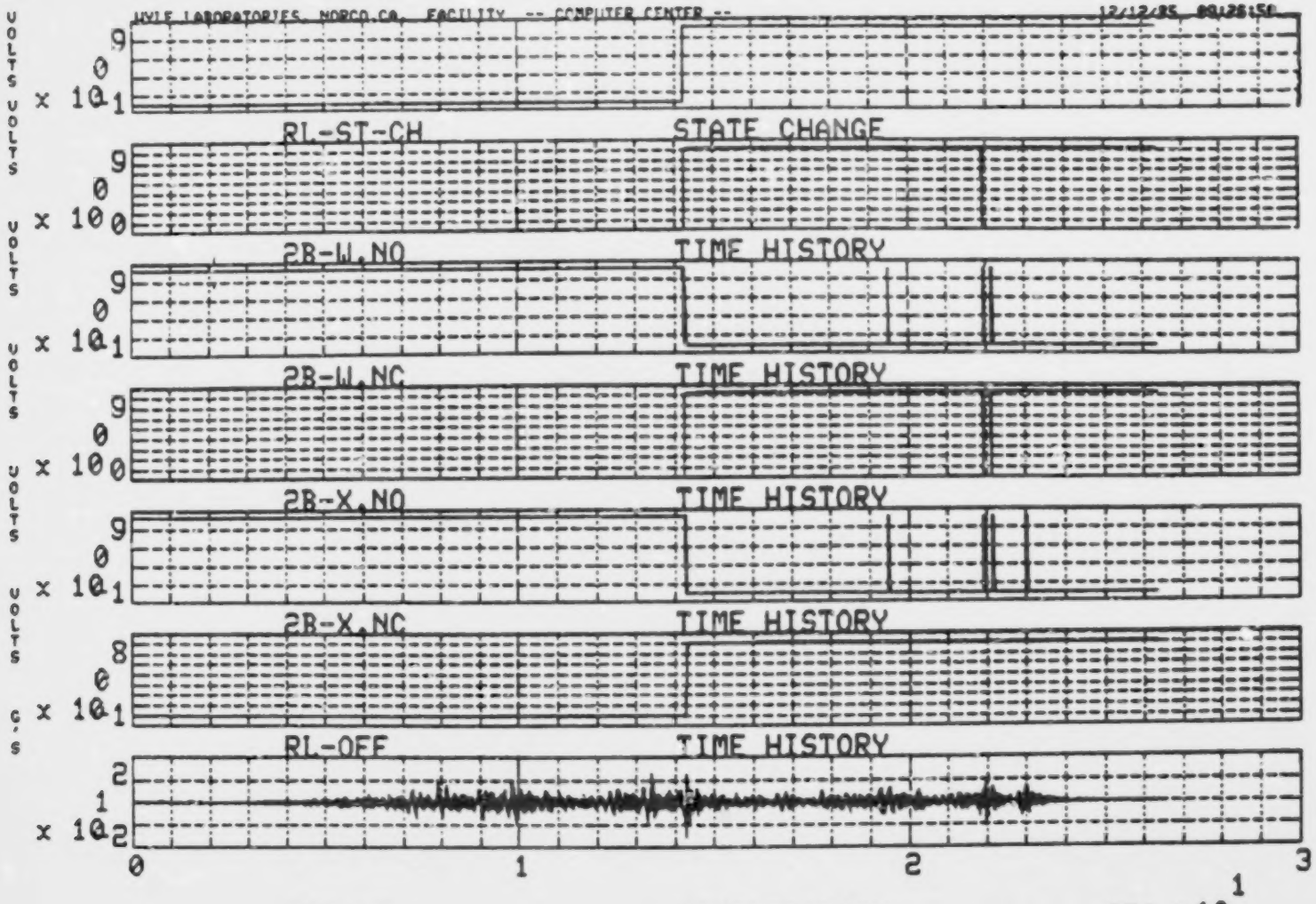
ACC-8 ACCELERATION

NO FILTER, 100 .00 SPS,

DATE 12/11/85 DISPLAY NUMBER 1 .00 TO 26.34 SEC

LLNL 26447,RUN 56,X-Y,5TH LEVEL/12 BOLTS/CAB.MOD, ON-OFF RV

BEST COPY AVAILABLE



ACC-10 ACCELERATION

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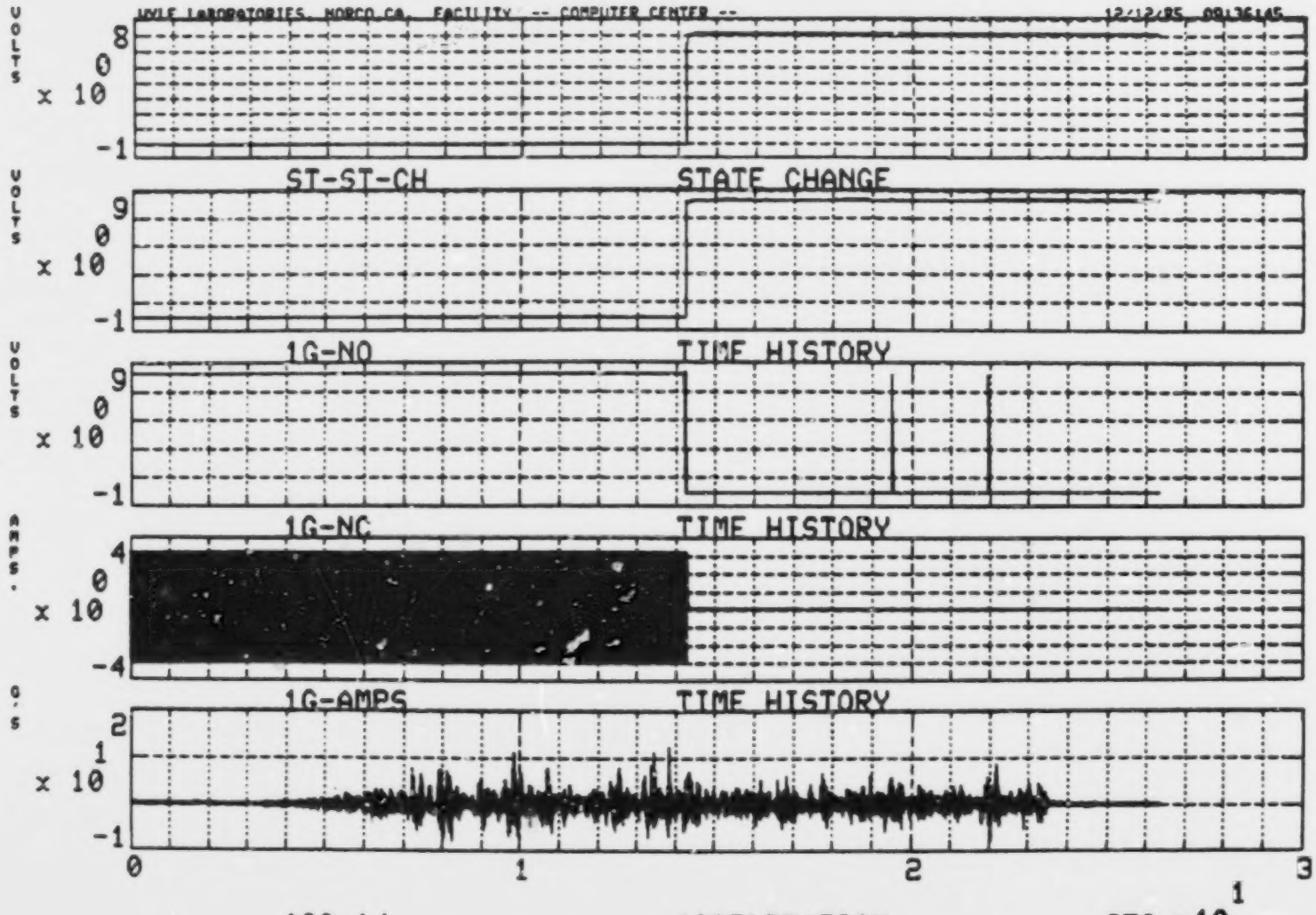
DATE 12/11/85 DISPLAY NUMBER 2 .00 TO 26.34 SEC

LLNL 26447,RUN 56,X-Y,5TH LEVEL/12 BOLTS/CAB.MOD, ON-OFF RV

BEST COPY AVAILABLE



ACC-14 ACCELERATION

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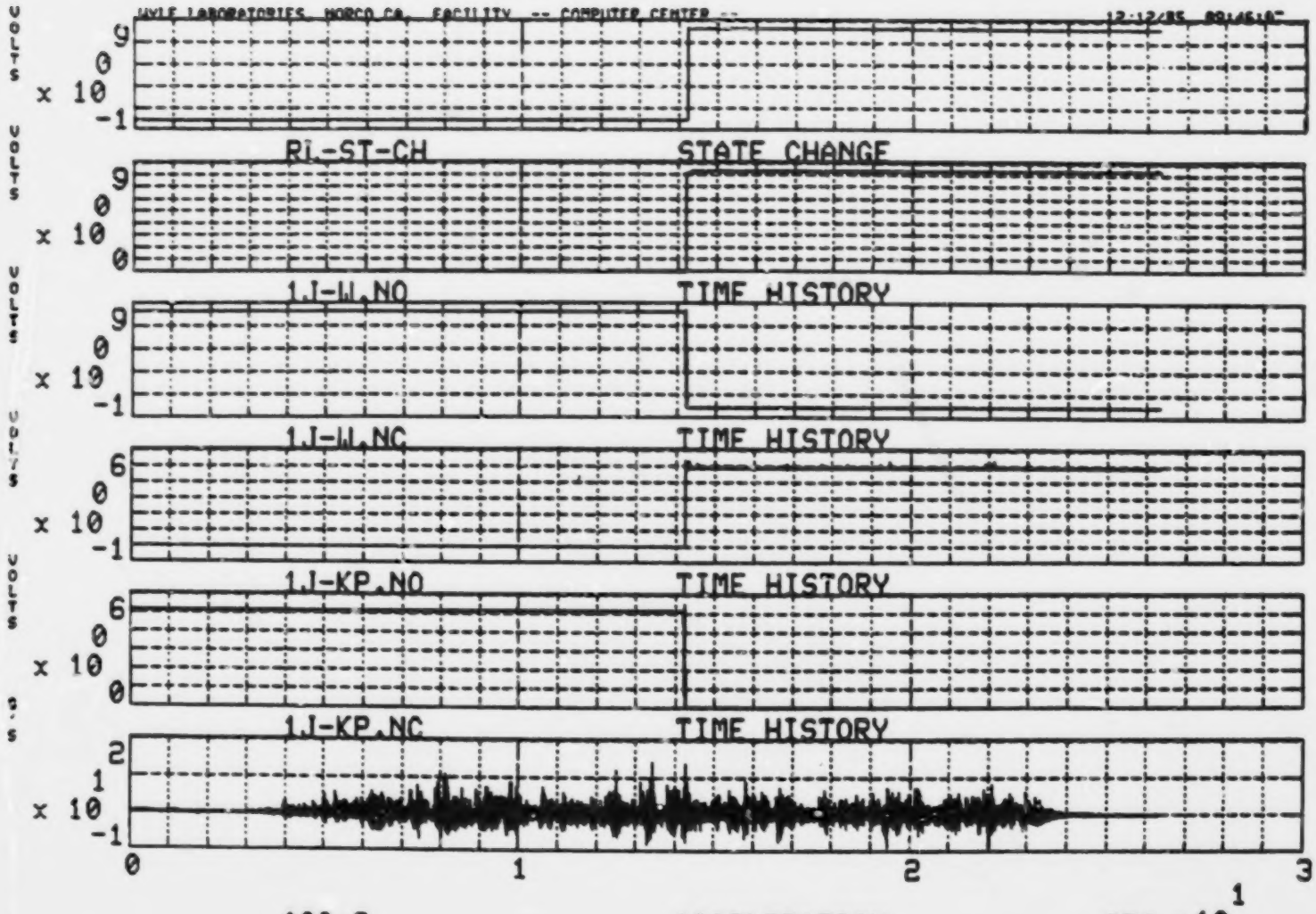
DATE 12/11/85 DISPLAY NUMBER 3 .00 TO 26.34 SEC

LLNL 26447,RUN 56,X-Y,5TH LEVEL/12 BOLTS/CAB.MOD, ON-OFF RV

BEST COPY AVAILABLE



ACC-3 ACCELERATION

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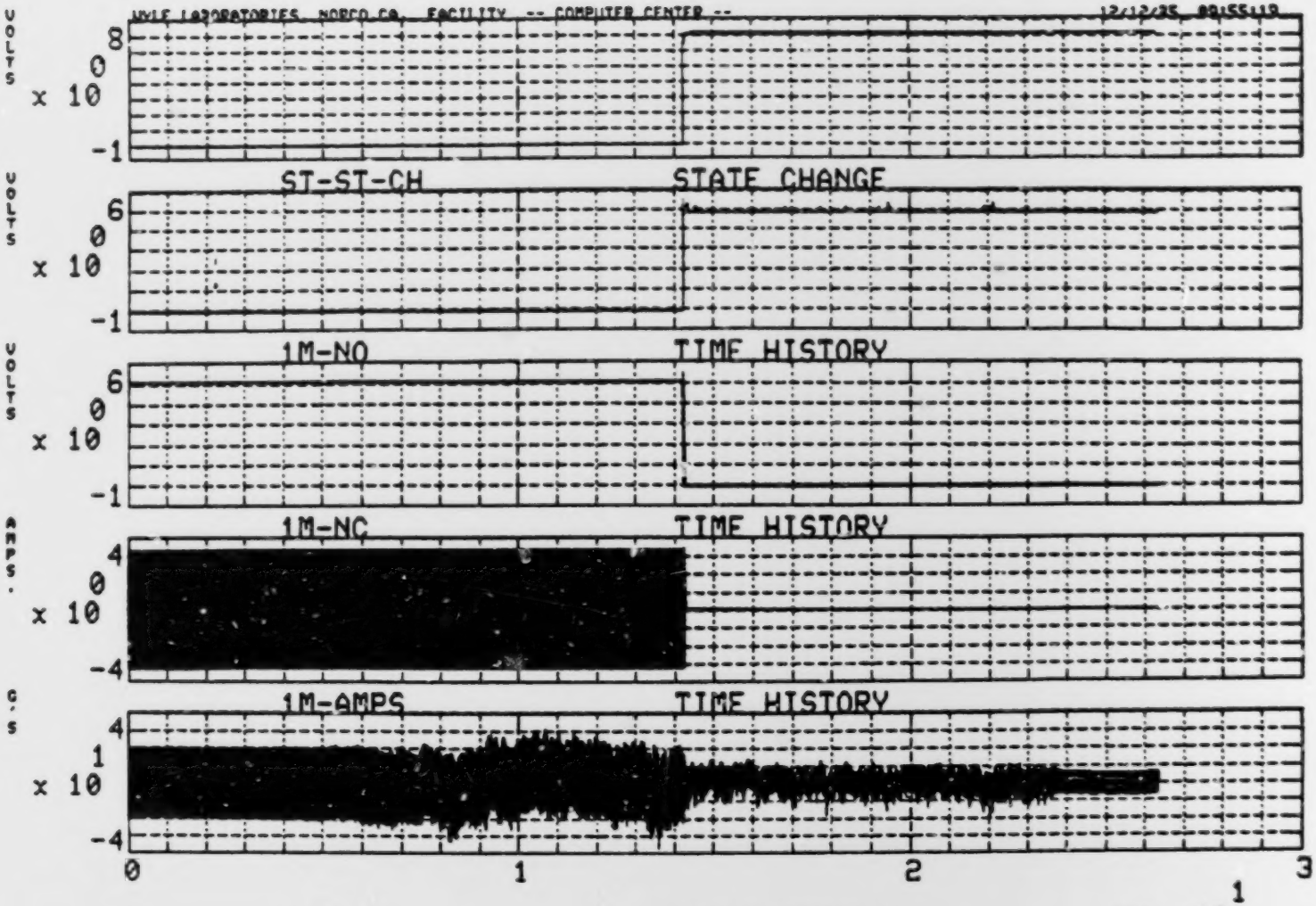
DATE 12/11/85 DISPLAY NUMBER 4 .00 TO 26.34 SEC

LLNL 26447,RUN 56,X-Y,5TH LEVEL/12 BOLTS/CAB.MOD, ON-OFF RV

BEST COPY AVAILABLE



ACC-18 ACCELERATION

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DATE 12/11/85 DISPLAY NUMBER 5 .00 TO 26.34 SEC

LLNL 26447,RUN 56,X-Y,5TH LEVEL/12 BOLTS/CAB.MOD, ON-OFF RU

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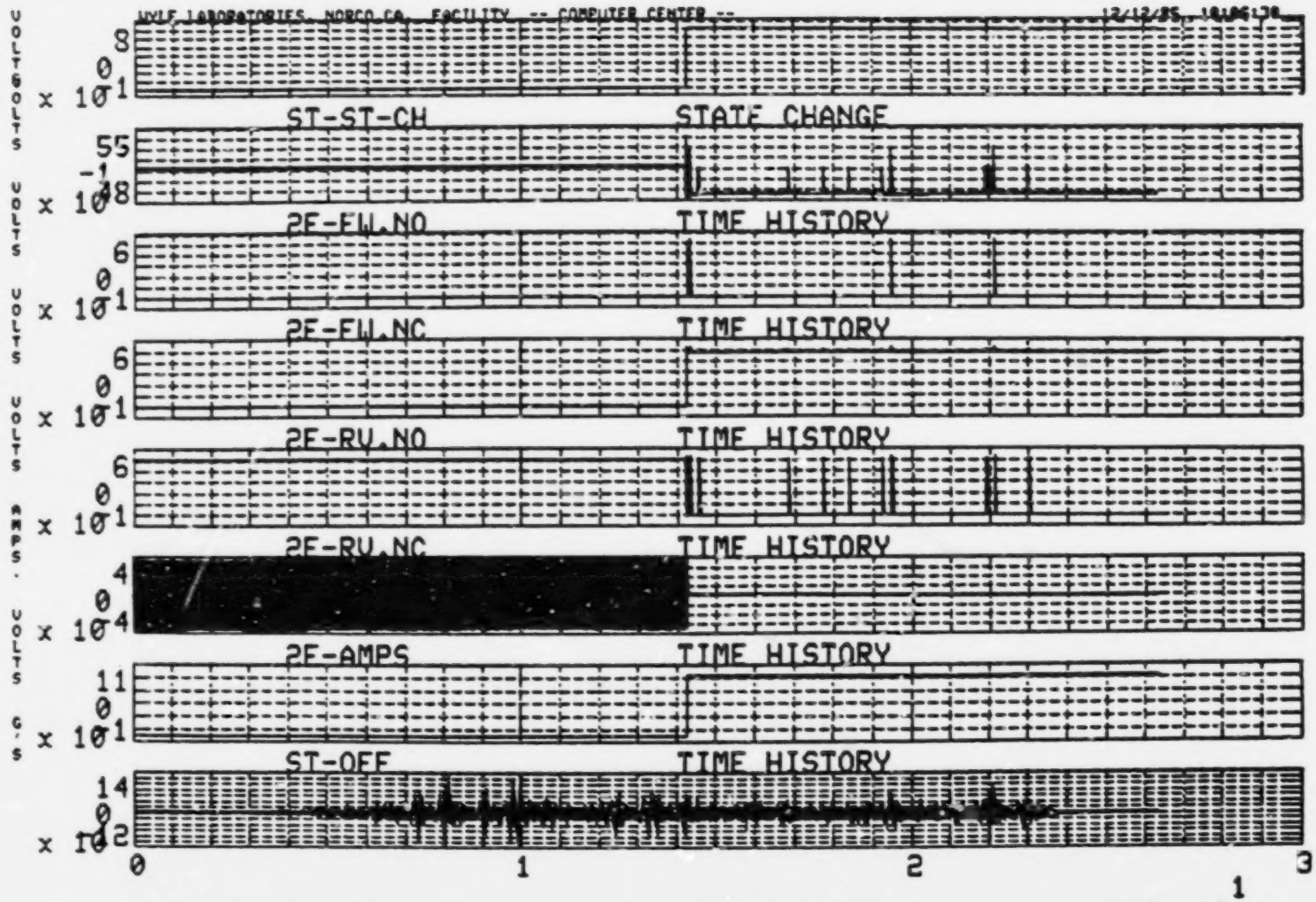

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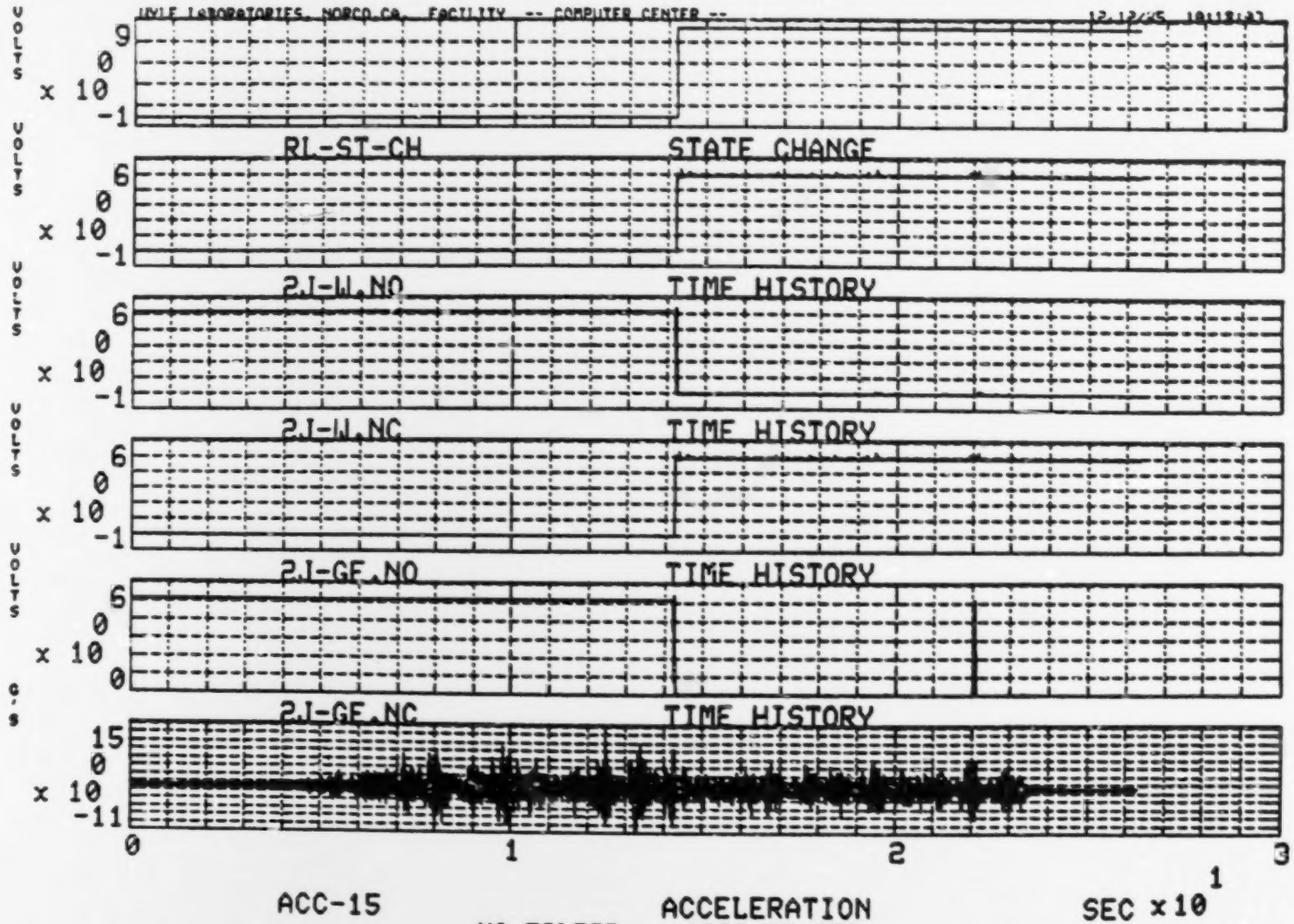
DATE 12/11/85 DISPLAY NUMBER 6 .00 TO 26.34 SEC

LLNL 26447,RUN 56,X-Y,5TH LEVEL/12 BOLTS/CAB.MOD, ON-OFF RV

BEST COPY AVAILABLE



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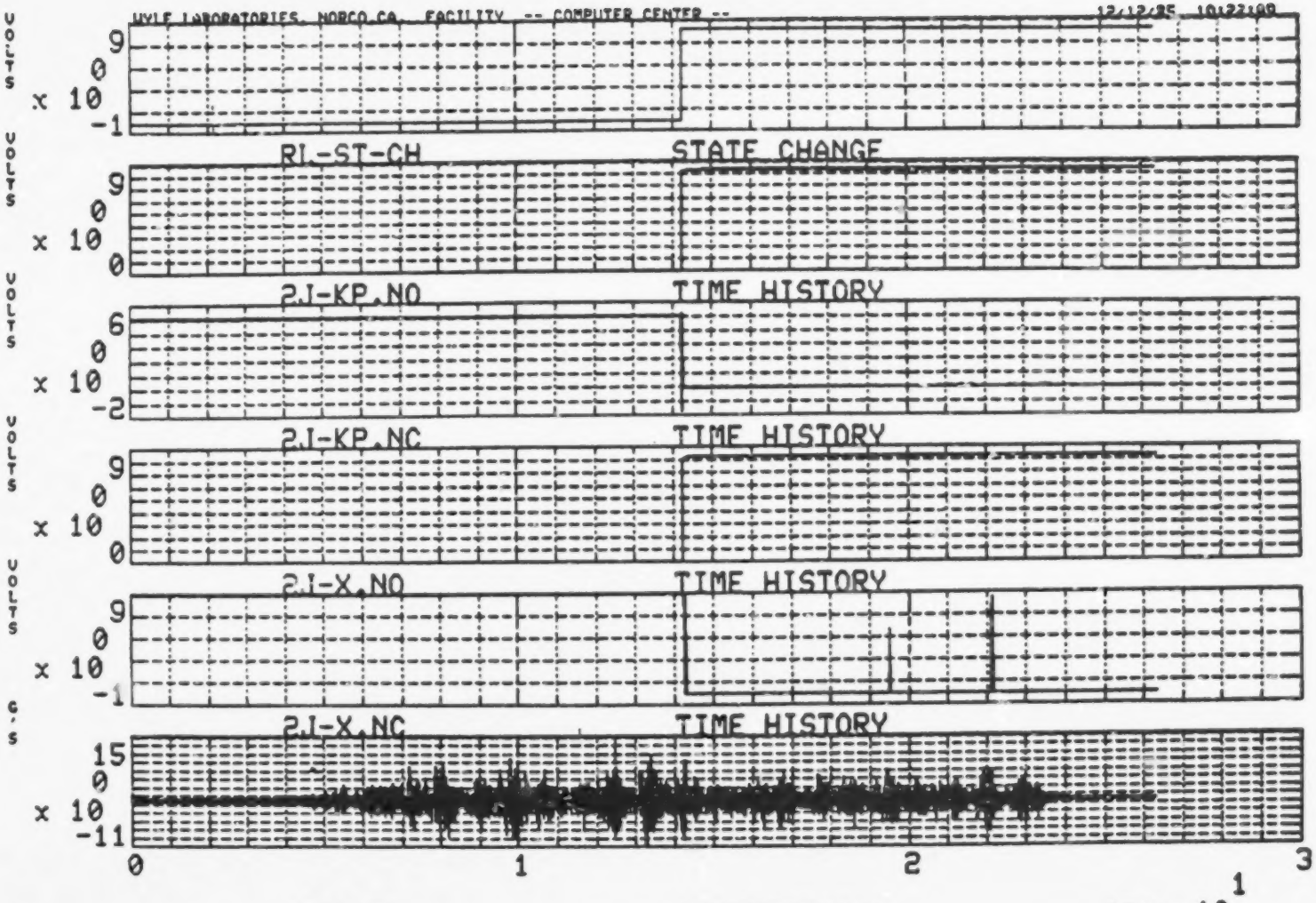
DATE 12/11/85 DISPLAY NUMBER 7 .00 TO 26.34 SEC

LLNL 26447,RUN 56,X-Y,5TH LEVEL/12 BOLTS/CAB.MOD, ON-OFF RV

BEST COPY AVAILABLE



ACC-15 ACCELERATION

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DATE 12/11/85 DISPLAY NUMBER 8 .00 TO 26.34 SEC

LLNL 26447,RUN 56,X-Y,5TH LEVEL/12 BOLTS/CAB.MOD, ON-OFF RV

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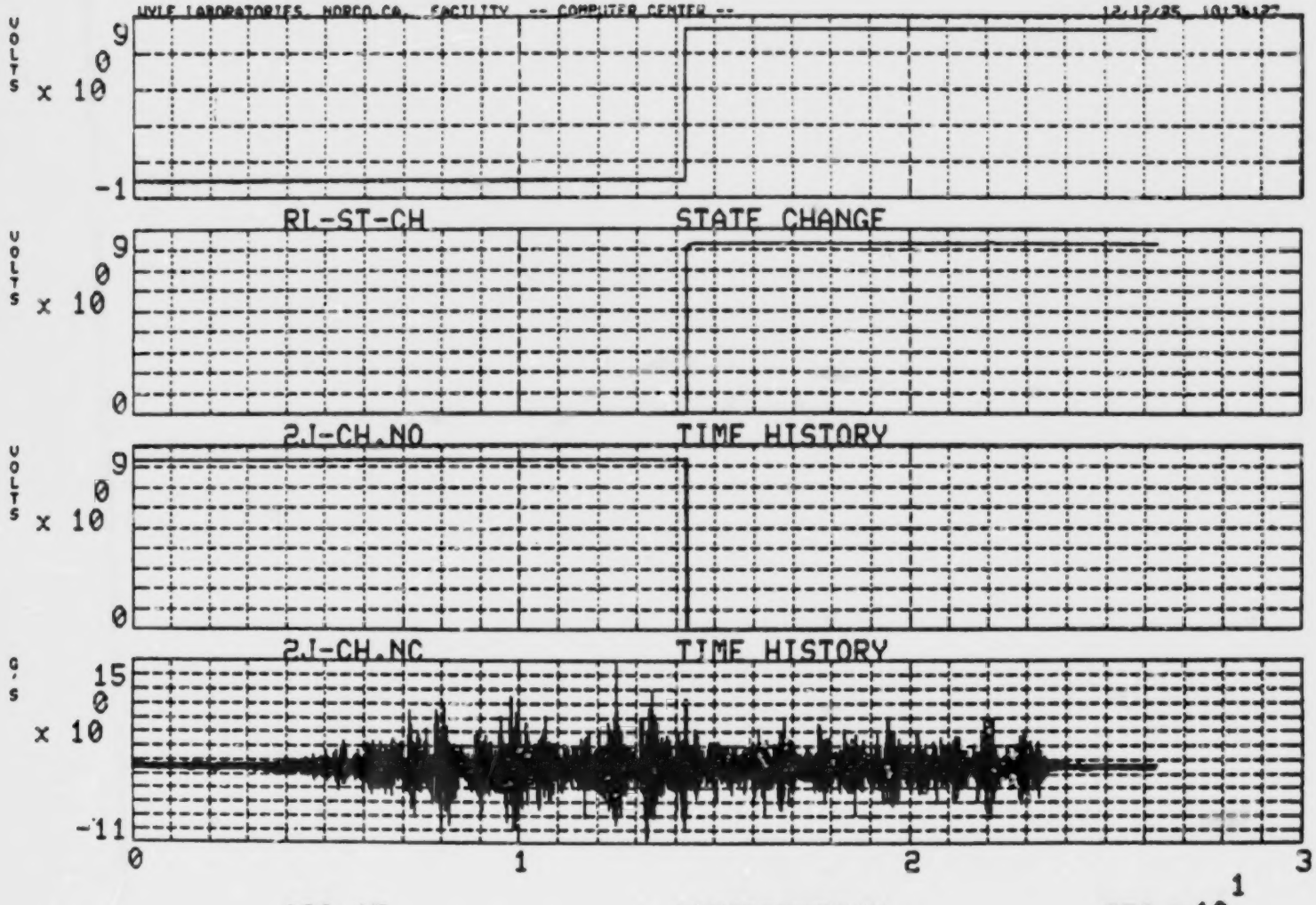

ACC-15 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 12/11/85 DISPLAY NUMBER 9 .00 TO 26.34 SEC

LLNL 26447,RUN 56,X-Y,5TH LEVEL/12 BOLTS/CAB.MOD, ON-OFF RJ

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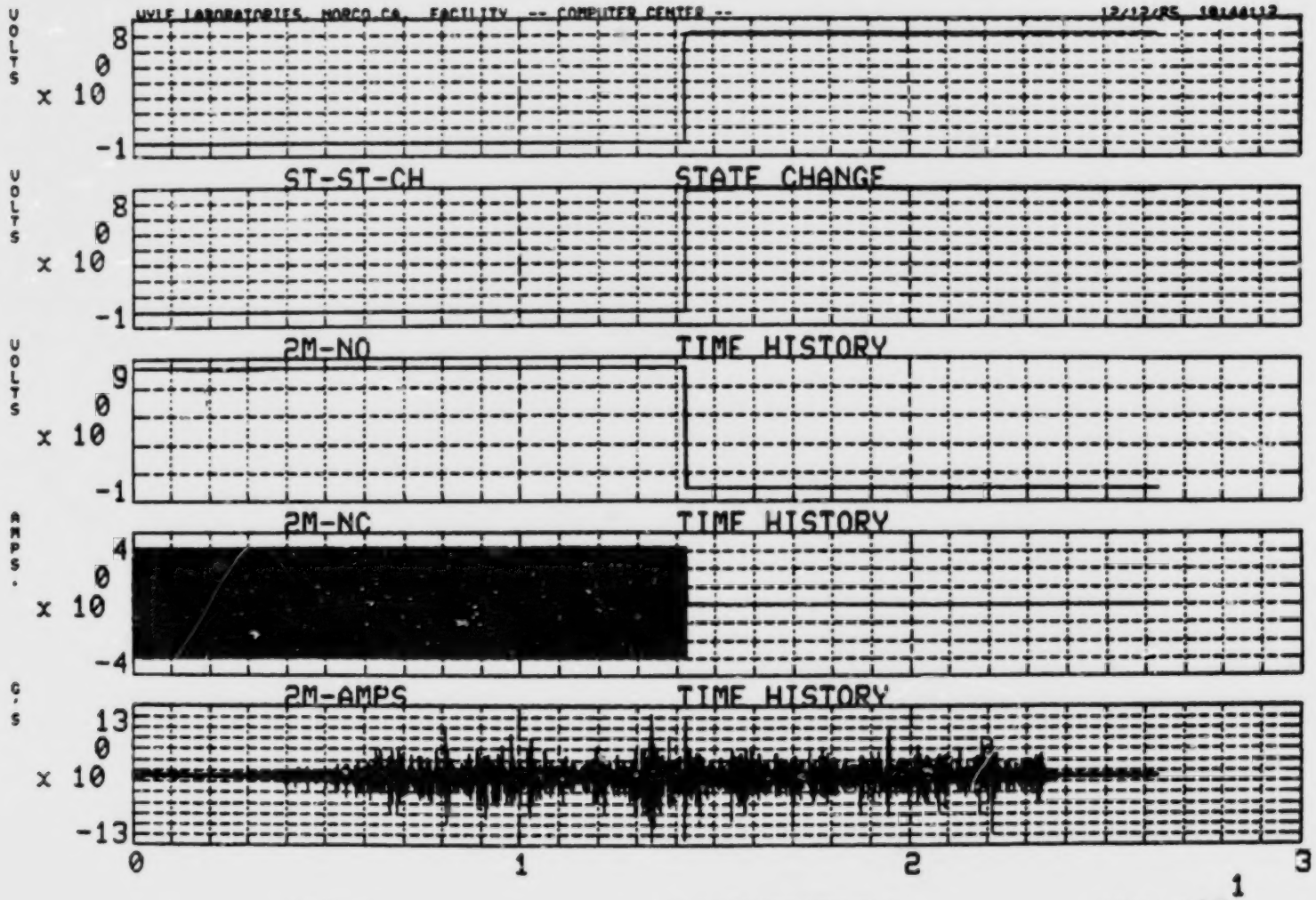

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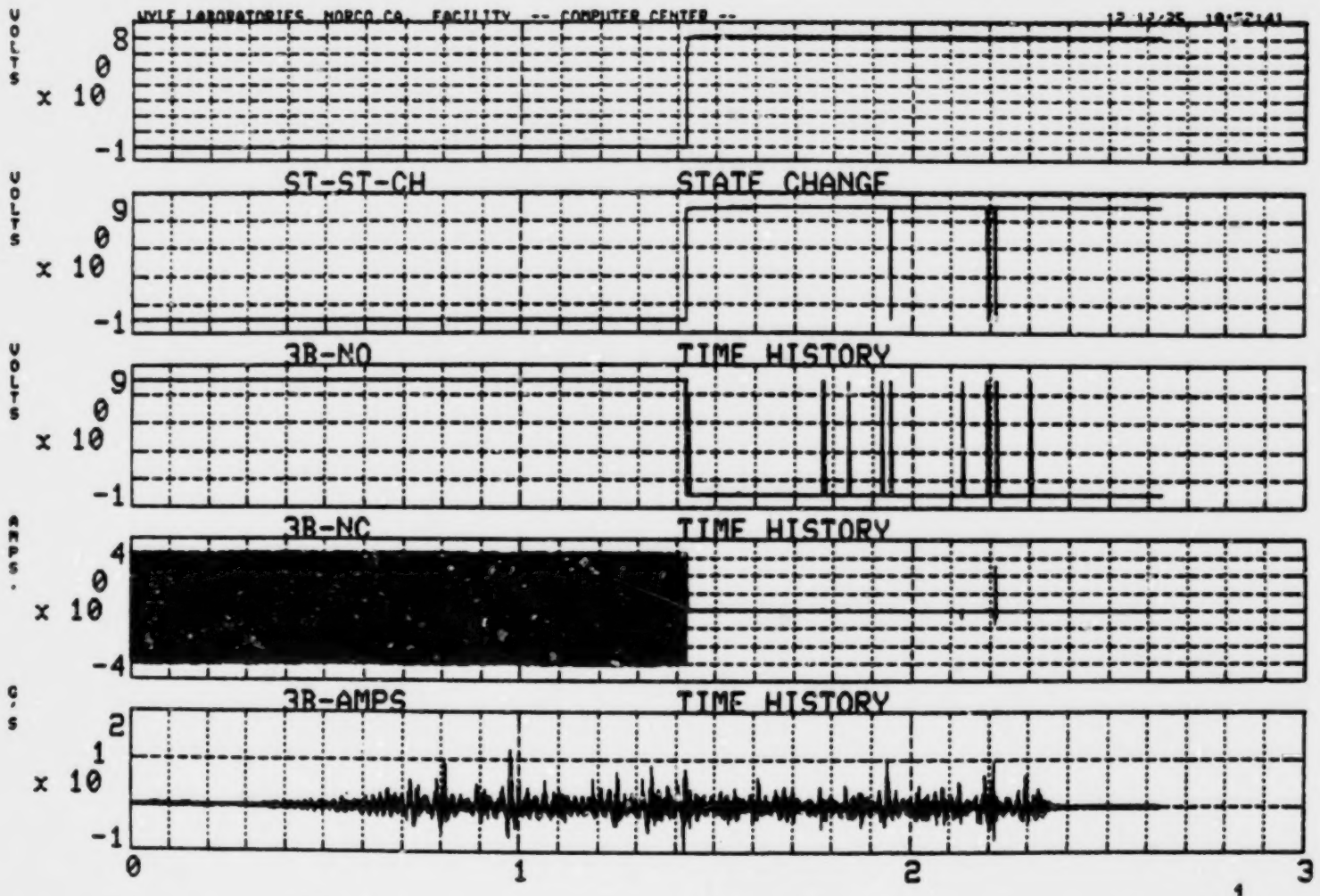
NO FILTER, 1000.00 SPS,

DATE 12/11/85 DISPLAY NUMBER 10 .00 TO 26.34 SEC

LLNL 26447,RUN 56,X-Y,5TH LEVEL/12 BOLTS/CAB.MOD, ON-OFF RV

BEST COPY AVAILABLE



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DATE 12/11/85 DISPLAY NUMBER 11 .00 TO 26.34 SEC

LLNL 26447,RUN 56,X-Y,5TH LEVEL/12 BOLTS/CAB.MOD, ON-OFF RV

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Page No. B-655

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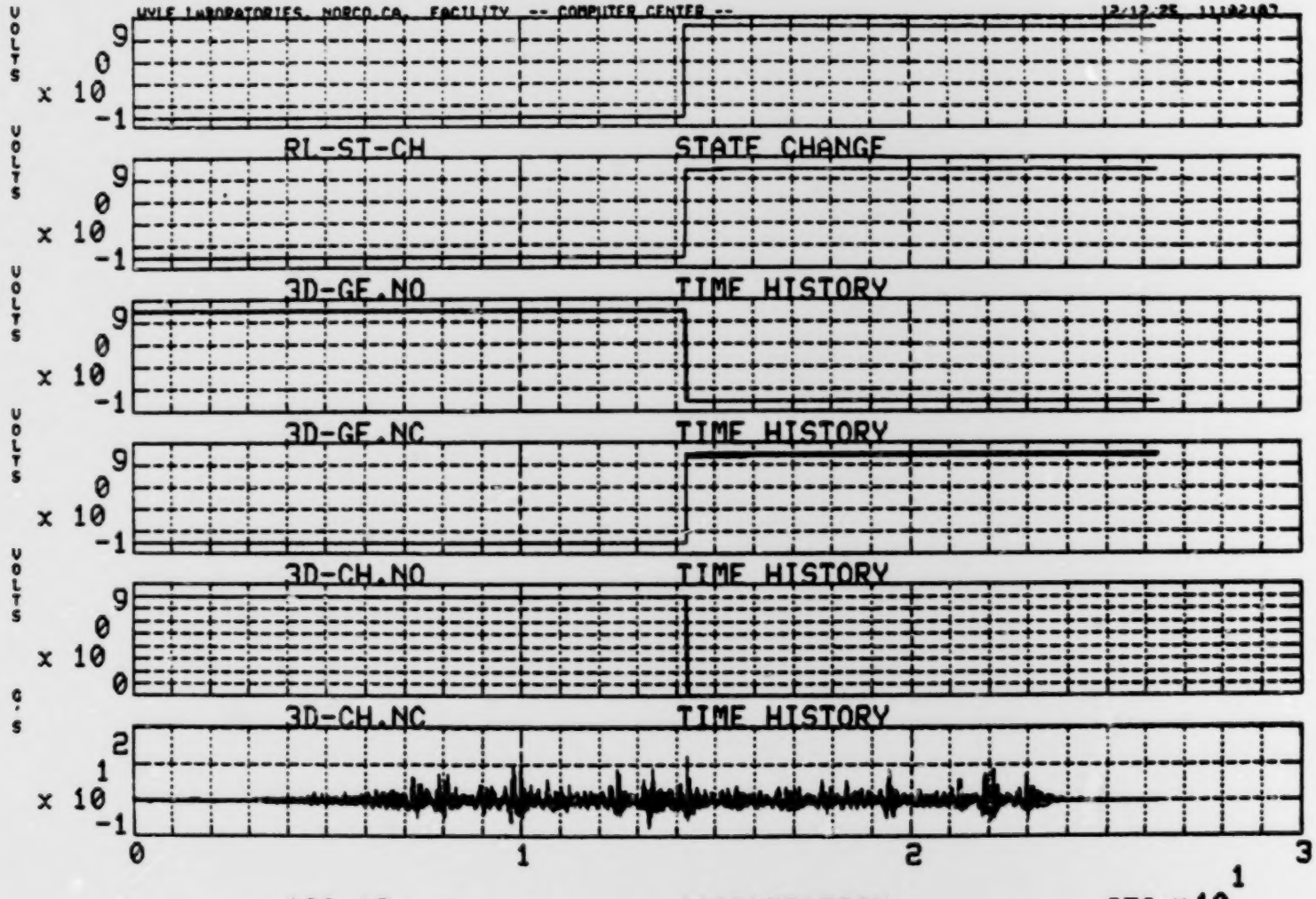

ACC-13 ACCELERATION

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LLNL 26447,RUN 56,X-Y,5TH LEVEL/12 BOLTS/CAB.MOD, ON-OFF RV

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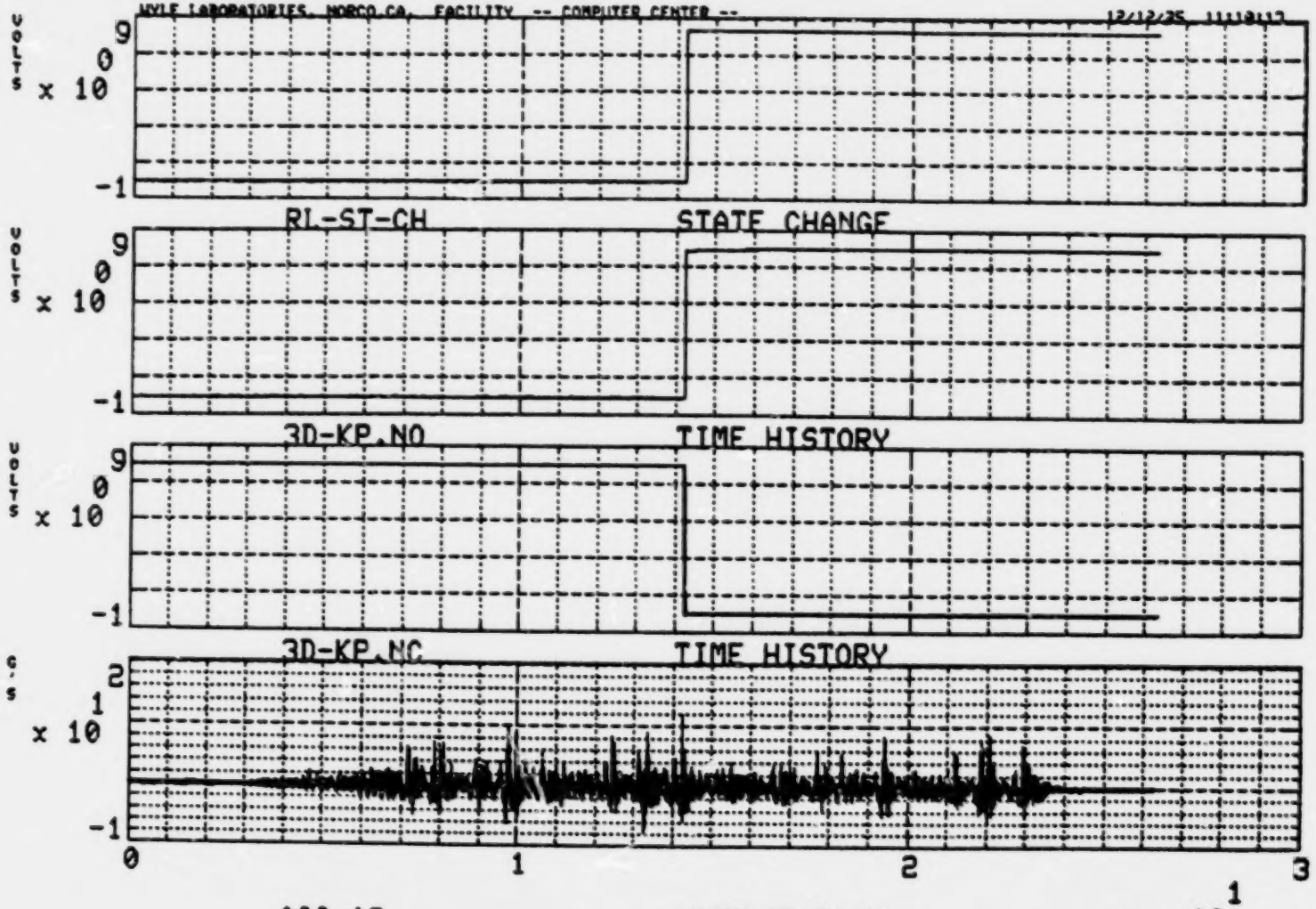

ACC-13 ACCELERATION

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DATE 12/11/85 DISPLAY NUMBER 13 .00 TO 26.34 SEC

LLNL 26447,RUN 56,X-Y,5TH LEVEL/12 BOLTS/CAB.MOD, ON-OFF RU

Report No. 26448

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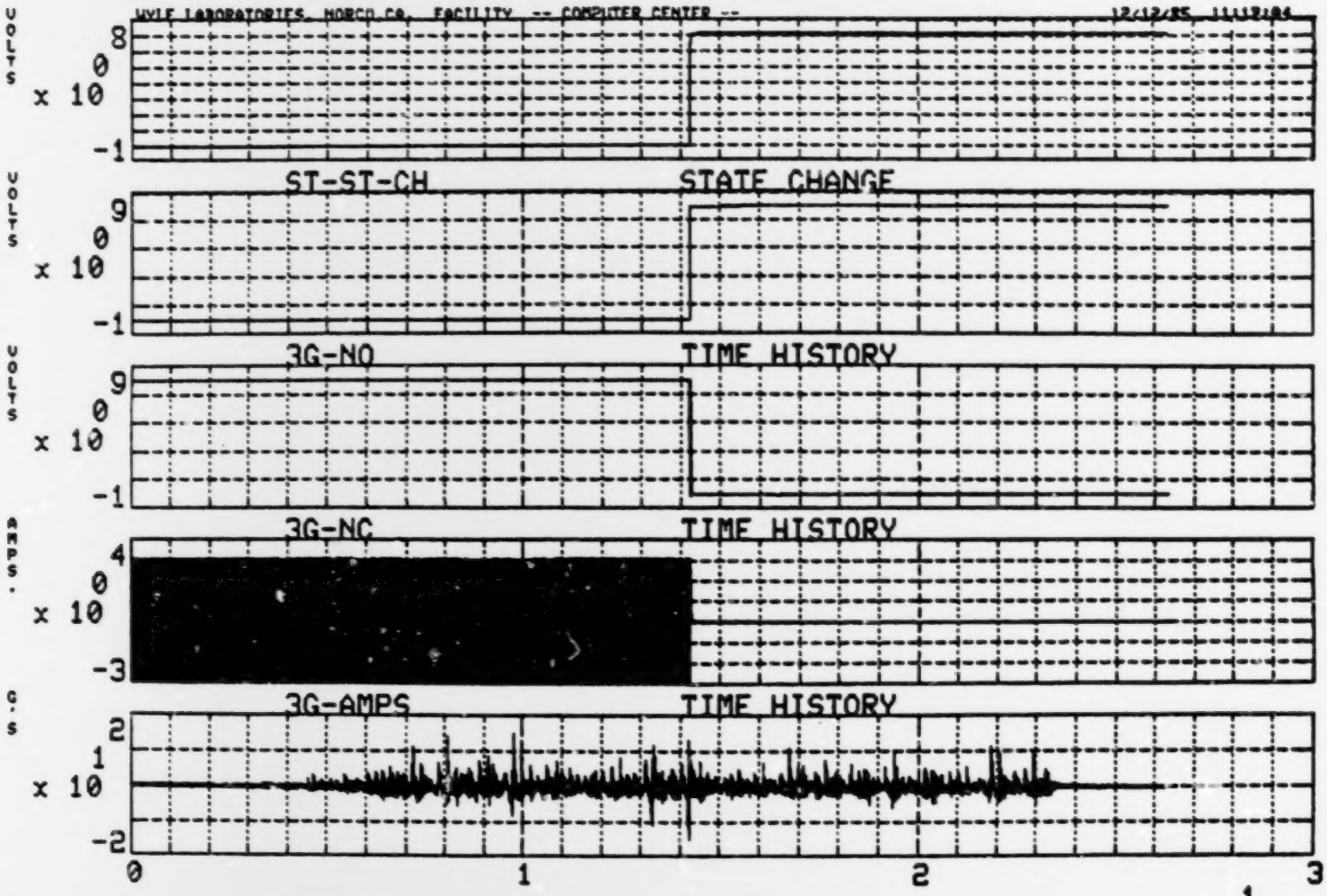

ACC-16 ACCELERATION

NO FILTER, 1000.00 SPS,

DATE 12/11/85 DISPLAY NUMBER 14 .00 TO 26.34 SEC

LLNL 26447,RUN 56,X-Y,5TH LEVEL/12 BOLTS/CAB.MOD, ON-OFF RV

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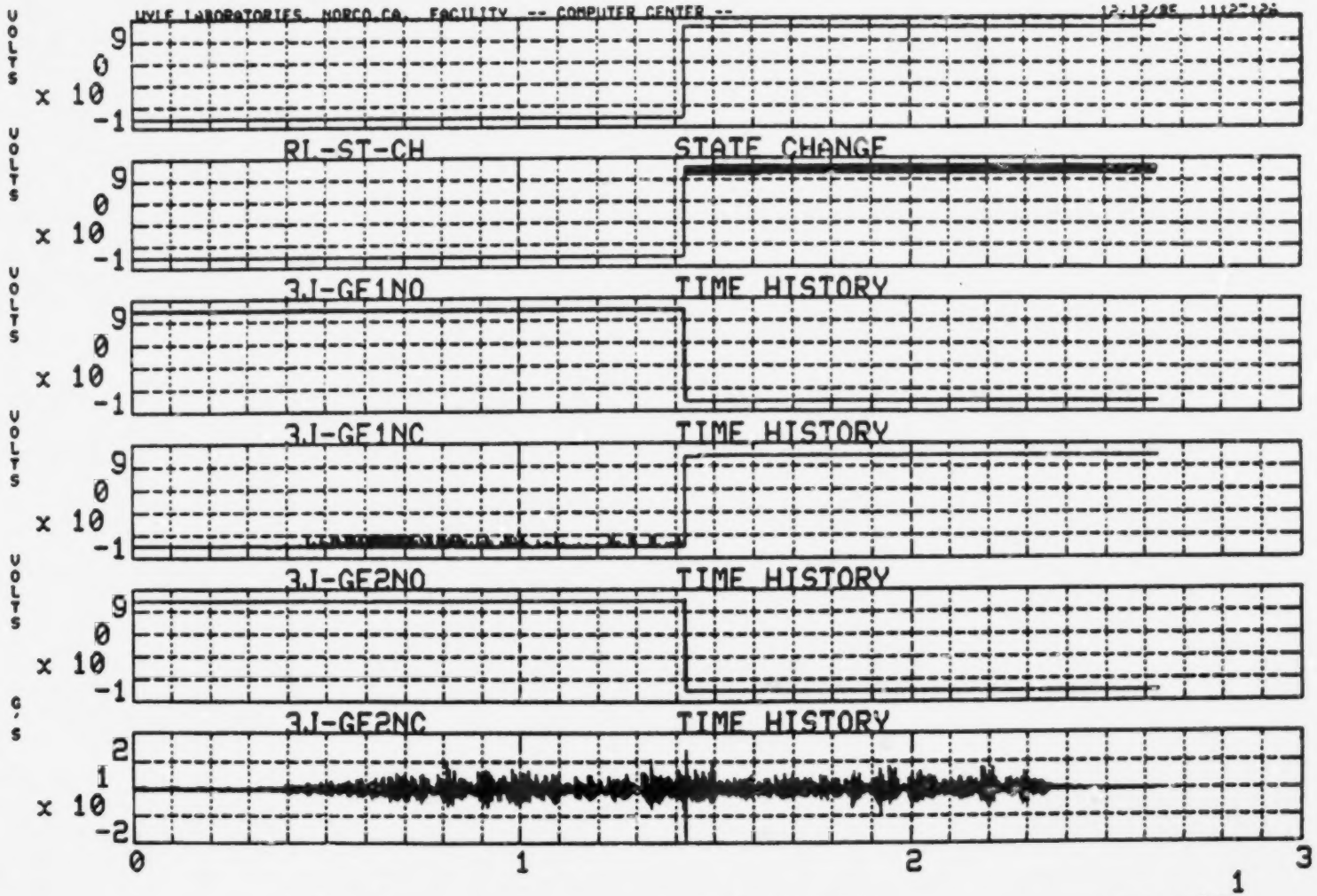

ACC-17 ACCELERATION

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DATE 12/11/85 DISPLAY NUMBER 15 .00 TO 26.34 SEC

LLNL 26447,RUN 56,X-Y,5TH LEVEL/12 BOLTS/CAB.MOD, ON-OFF RV

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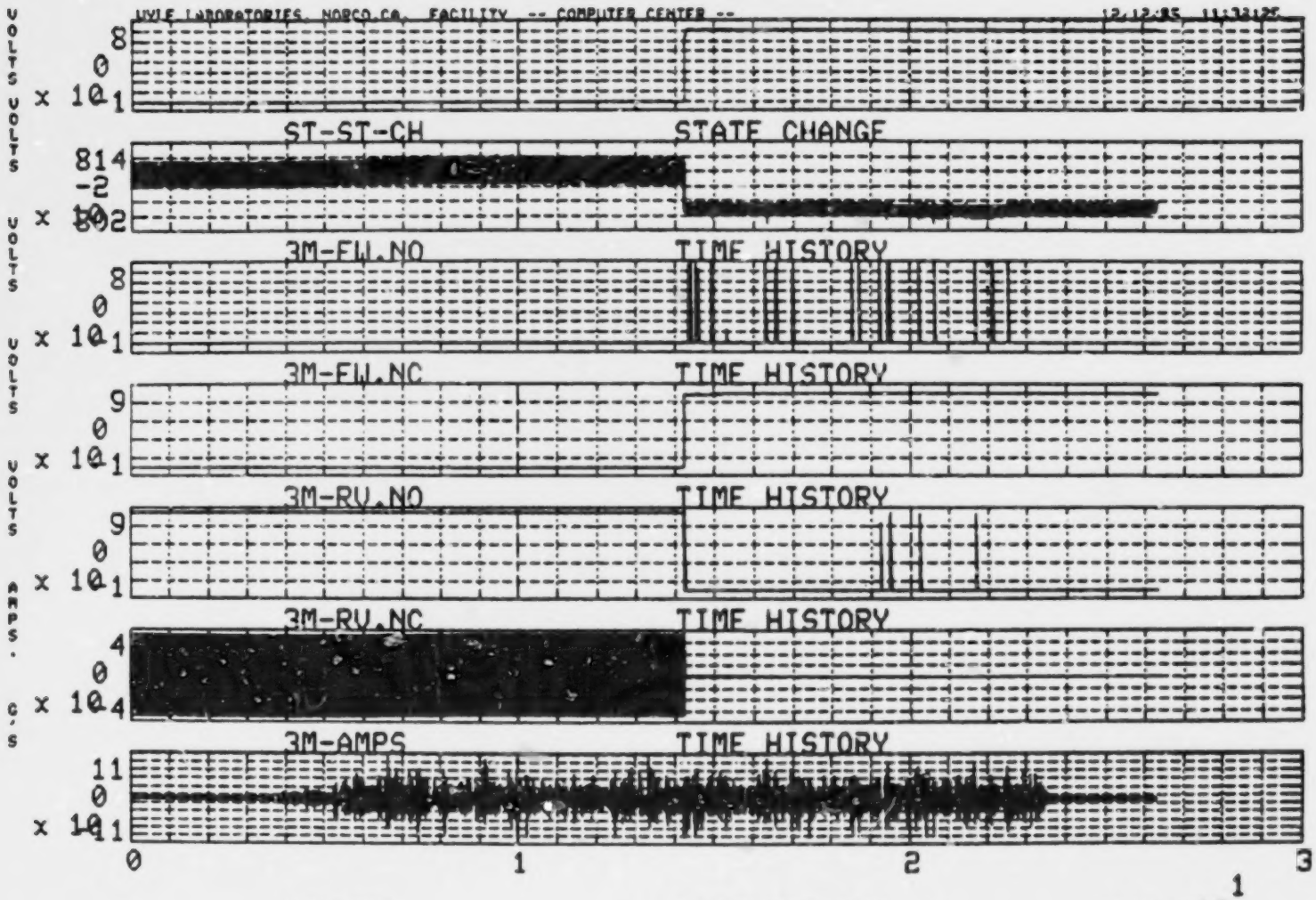

ACC-19 ACCELERATION

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DATE 12/11/85 DISPLAY NUMBER 16 .00 TO 26.34 SEC

LLNL 26447,RUN 56,X-Y,5TH LEVEL/12 BOLTS/CAB.MOD, ON-OFF RV

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APPENDIX D

Response Spectra from Runs 17, 31, 46, and 56

APPENDIX D

This appendix presents test response spectra from Runs 17, 31, 46, and 56 showing local in-cabinet response at the location of each device and at the cabinet base. In these tests, the MCC was subjected to the most severe input motion applied to each mounting configuration with horizontal table input (in each case oriented in the F-B cabinet direction) ranging from 2.1 to 2.5g ZPA. Equivalent information for all runs is included in the final test report submitted to LLNL by Wyle Laboratories.*

---

*Wyle Laboratories, Scientific Services and Systems Group, Seismic Fragility Evaluation of a Motor Control Center for Lawrence Livermore National Laboratory (May 1986).

R U N 1 7

Four bolts per column with top brace, 2.1g table ZPA

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L. L. N. L. Job No. 26447 Date 10-3-85

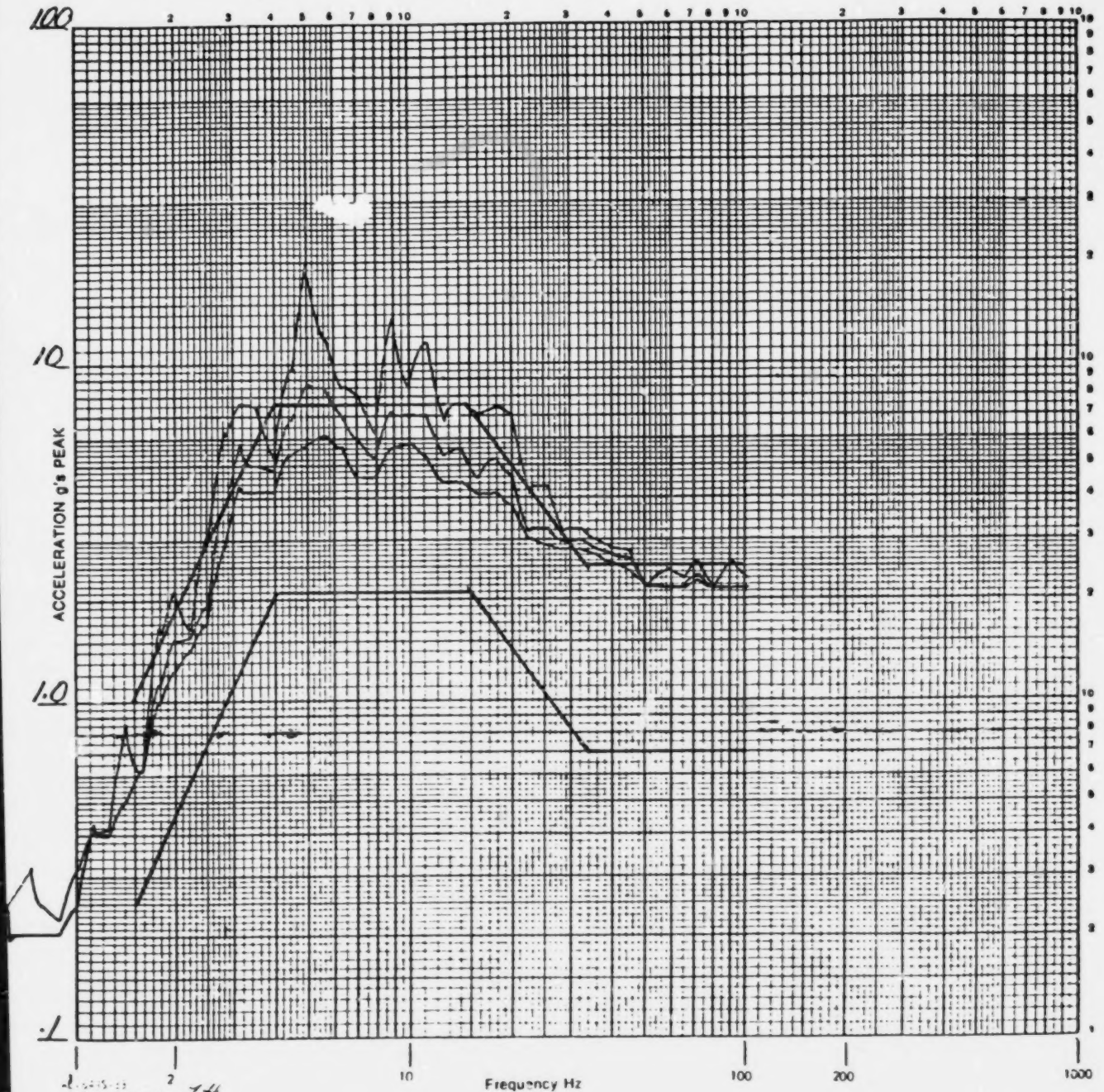
Specimen MOTOR CONTROL CENTER Axis of Test X-Y

Accel. No. 1 Axis HORIZ Control (✓) Response ( ) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 17

Operator GREIERMAN Engineer JM 5% LEVEL 30HZ

RESPONSE SPECTRUM



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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L. L. N. L. Job No. 26447 Date 10-3-85

Specimen MOTOR CONTROL CENTER Axis of Test X-Y

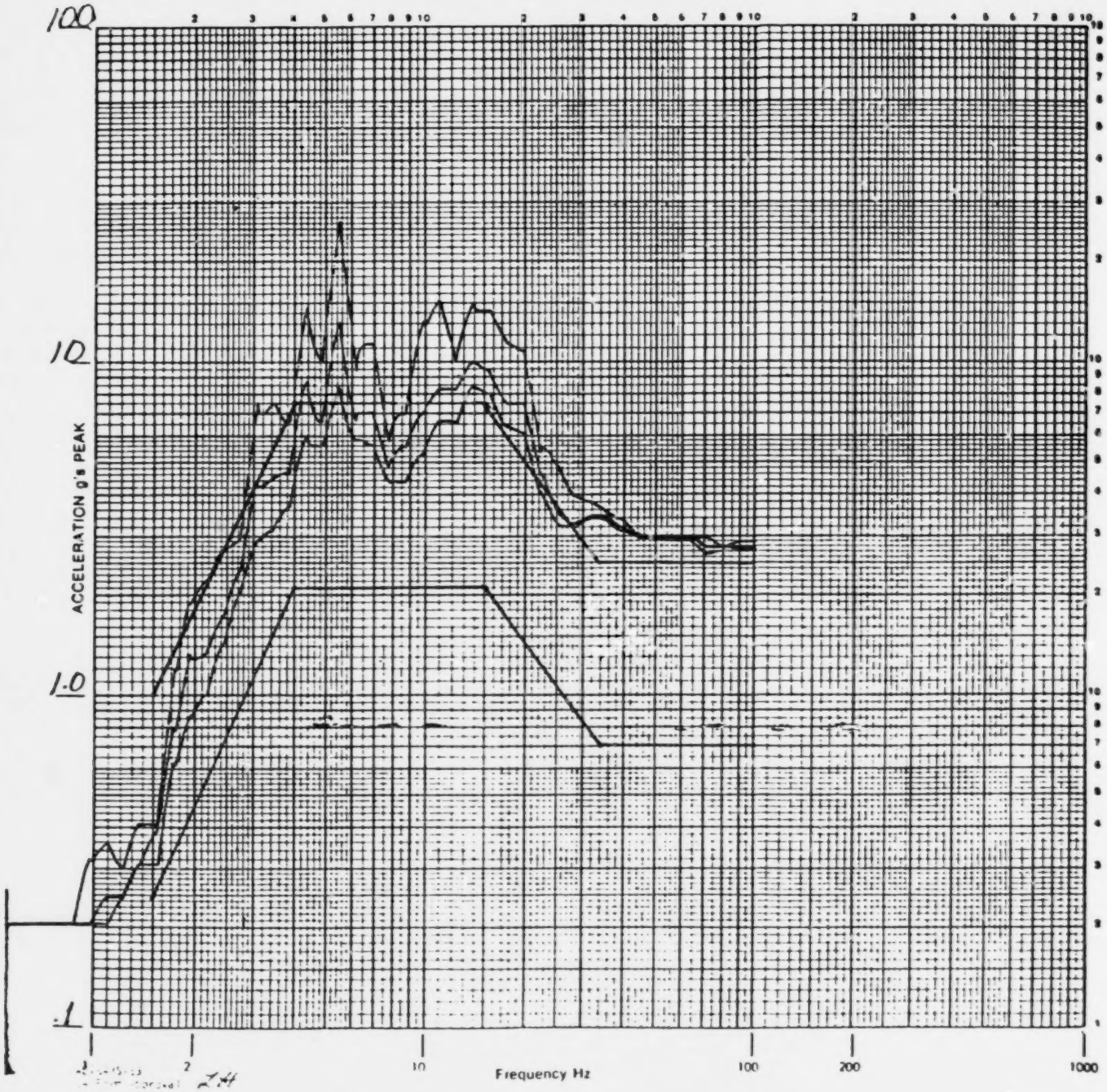
Accel. No. 2 Axis VERT Control (✓) Response ( ) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5%, 3 % Run No. 17

Operator GREIFFMAN Engineer

5TH LEVEL 30HZ

RESPONSE SPECTRUM



2.52

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L. Job No. 26447 Date 10-3-85

Specimen MOTOR CONTROL UNIT Axis of Test X-Y

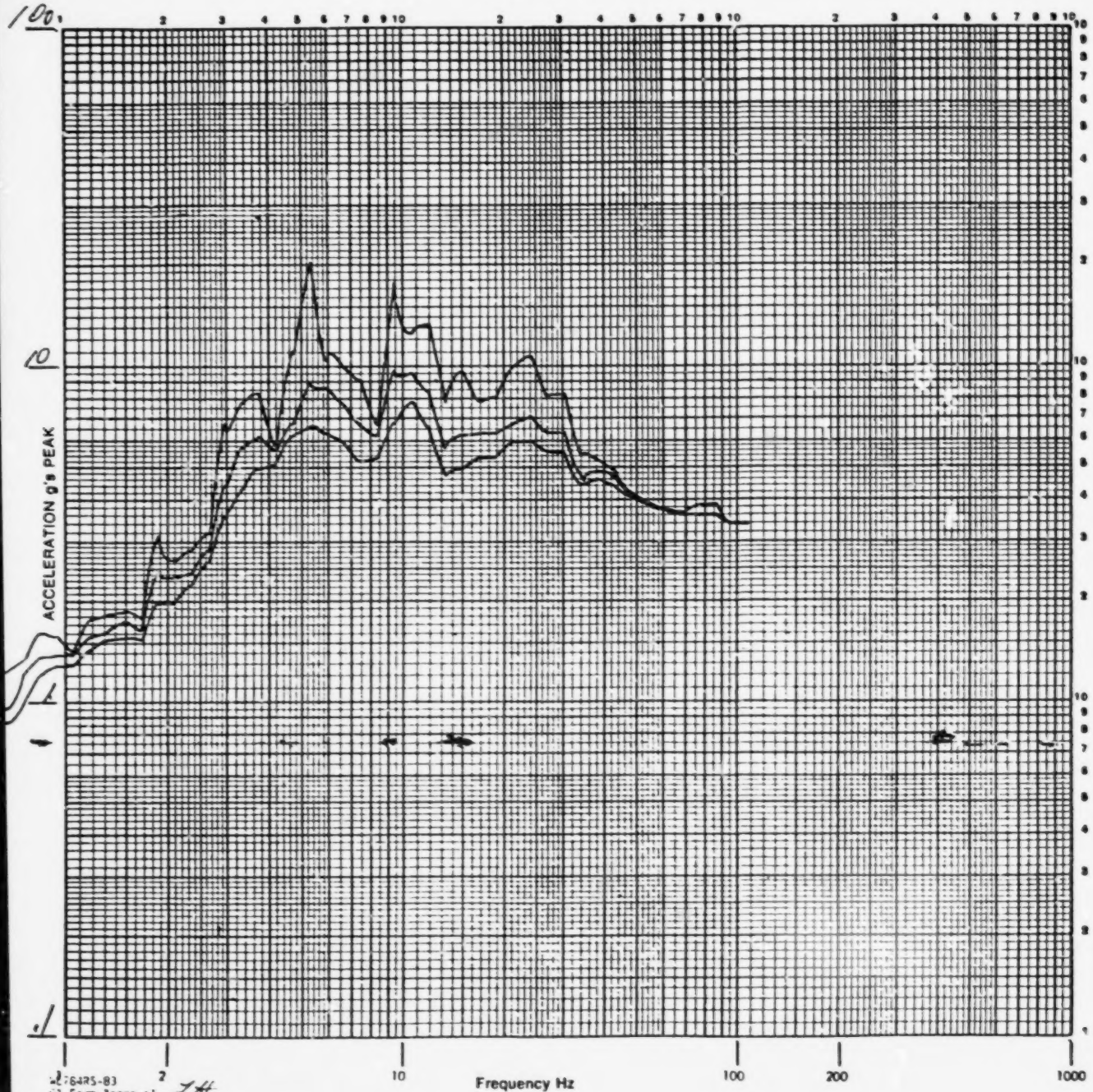
Accel. No. 5 Axis Y Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 17

Operator GREENEMAN Engineer

5% Level 30HZ

RESPONSE SPECTRUM



2276425-83
QA Form Approval ZH

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

Report No. 26448

Page No. B-162

CUSTOMER L-L.N.L Job No. 26447 Date 10-3-85

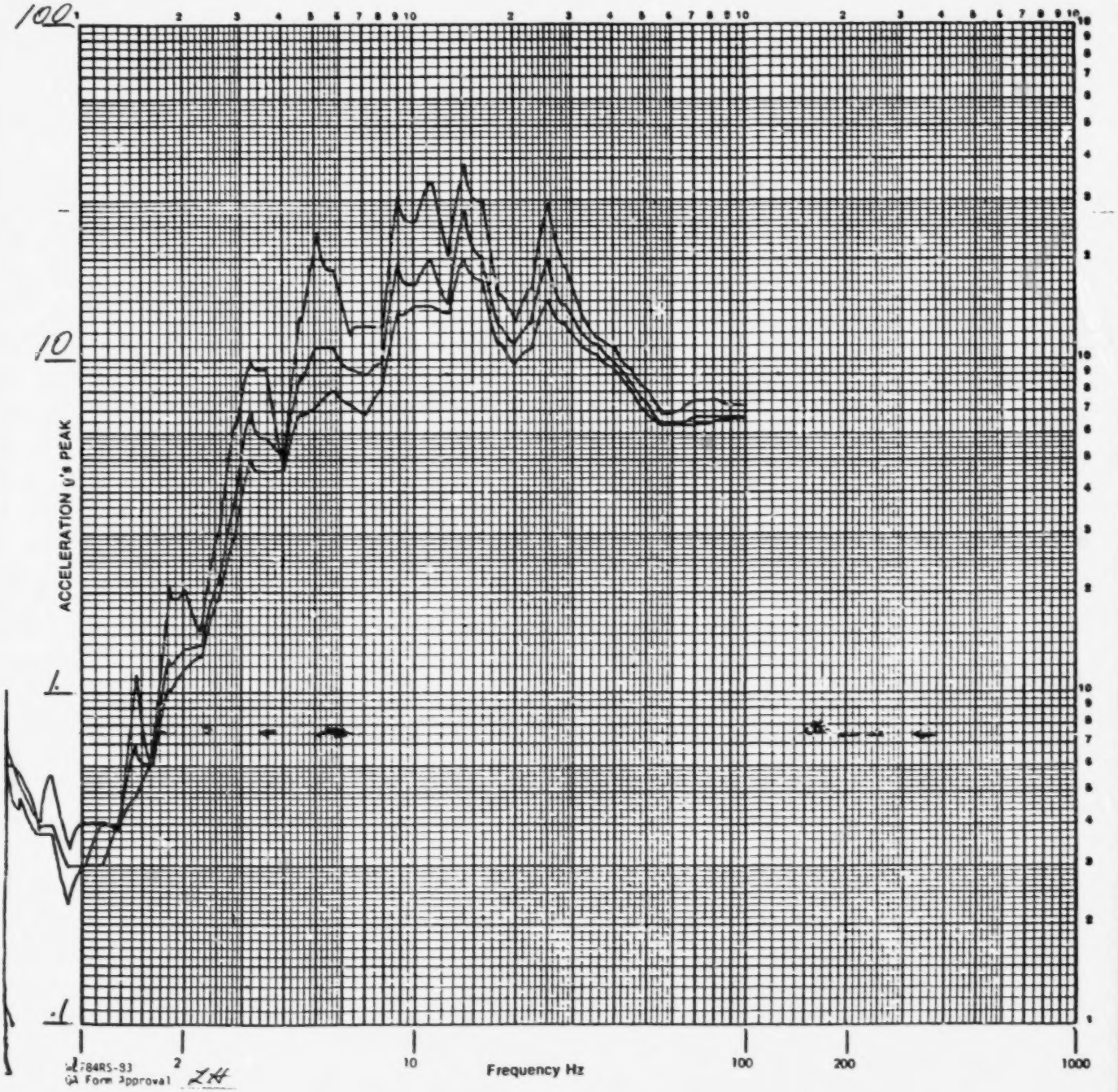
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 8 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 17

Operator GREIBERMAN Engineer [illegible] 5th LEVEL 30 HZ

RESPONSE SPECTRUM



WL784RS-83
QA Form Approval LH

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L. Job No. 26447 Date 10-3-85

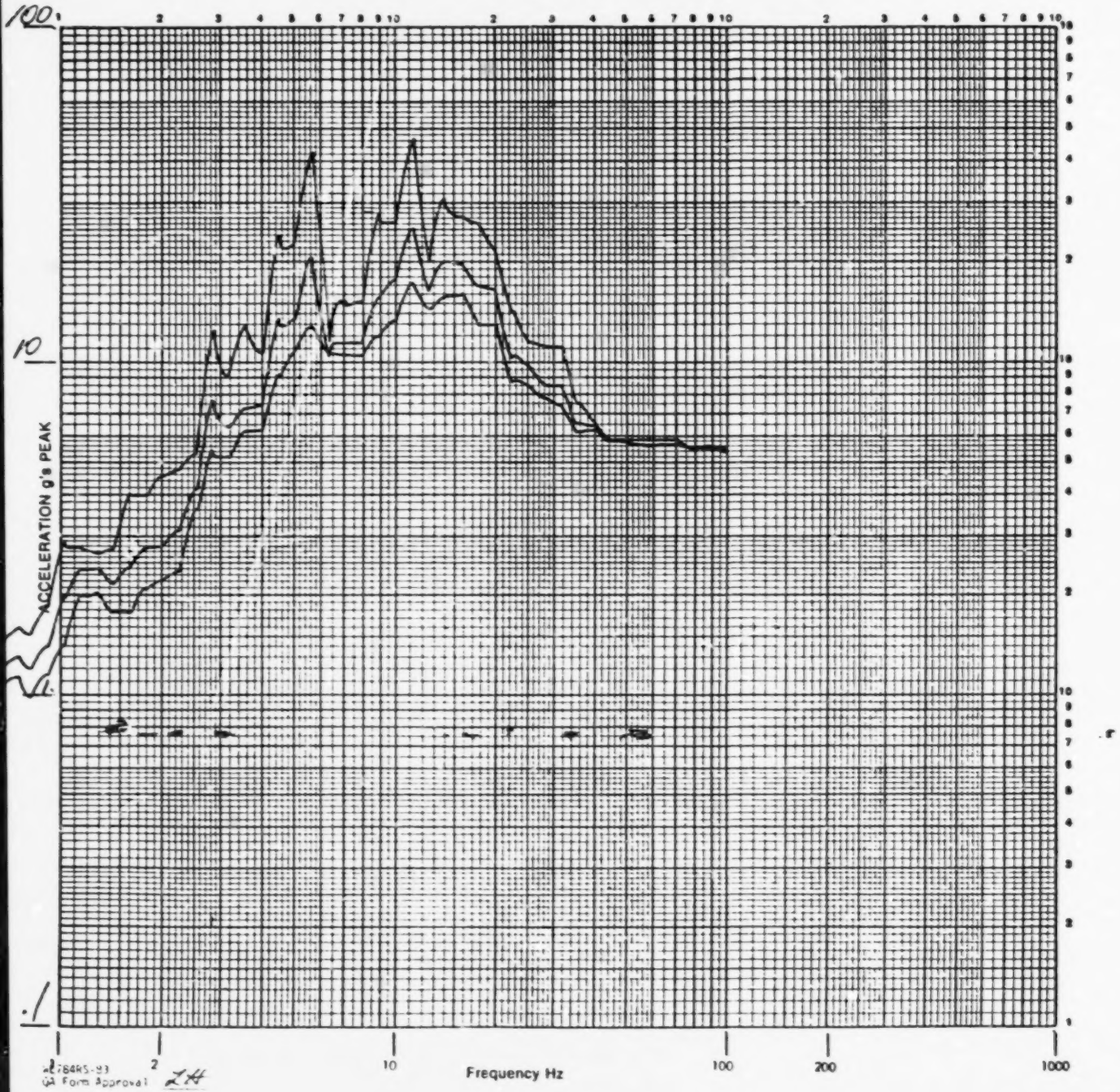
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 9 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 17

Operator GREENEMAN Engineer [signature] 5TH LEVEL 3042

RESPONSE SPECTRUM



2784RS-93
QA Form Approval ZH

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L. Job No. 26447 Date 10-3-85

Specimen MOTOR CONTROL UNIT Axis of Test X-Y

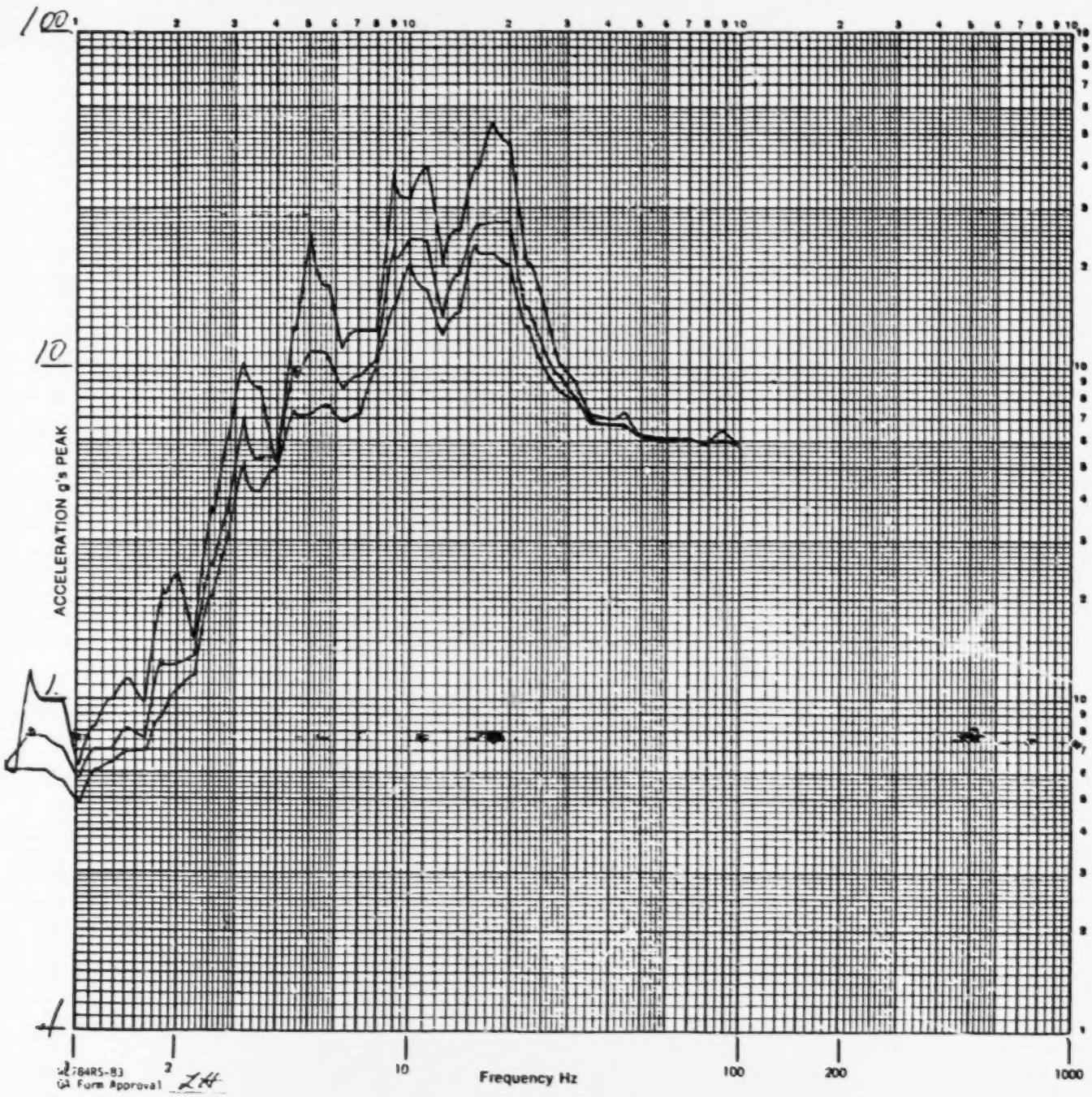
Accel. No. 10 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5+1+3 % Run No. 17

Operator GREENMAN Engineer

5% LEVEL 30 HZ

RESPONSE SPECTRUM



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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

CUSTOMER L.L.N.L. Job No. 26447 Date 10-3-85

Specimen MOTOR CONTROL UNIT Axis of Test X-Y

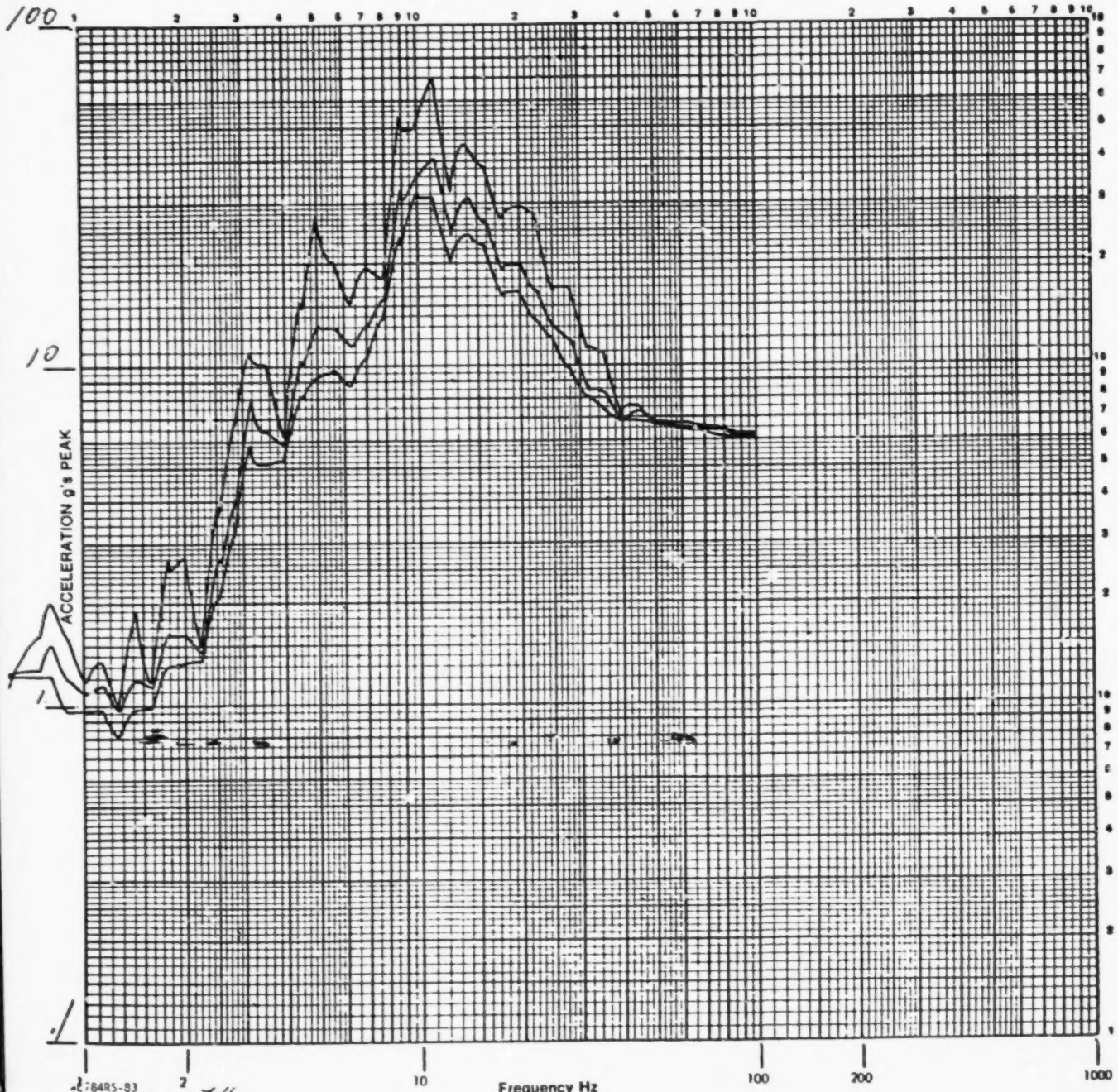
Accel. No. 11 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5,4,3 % Run No. 17

Operato GREENMAN Engineer [illegible]

5TH LEVEL 30Hz

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 10-3-85

Specimen MOTOR CONTROL UNIT Axis of Test X-Y

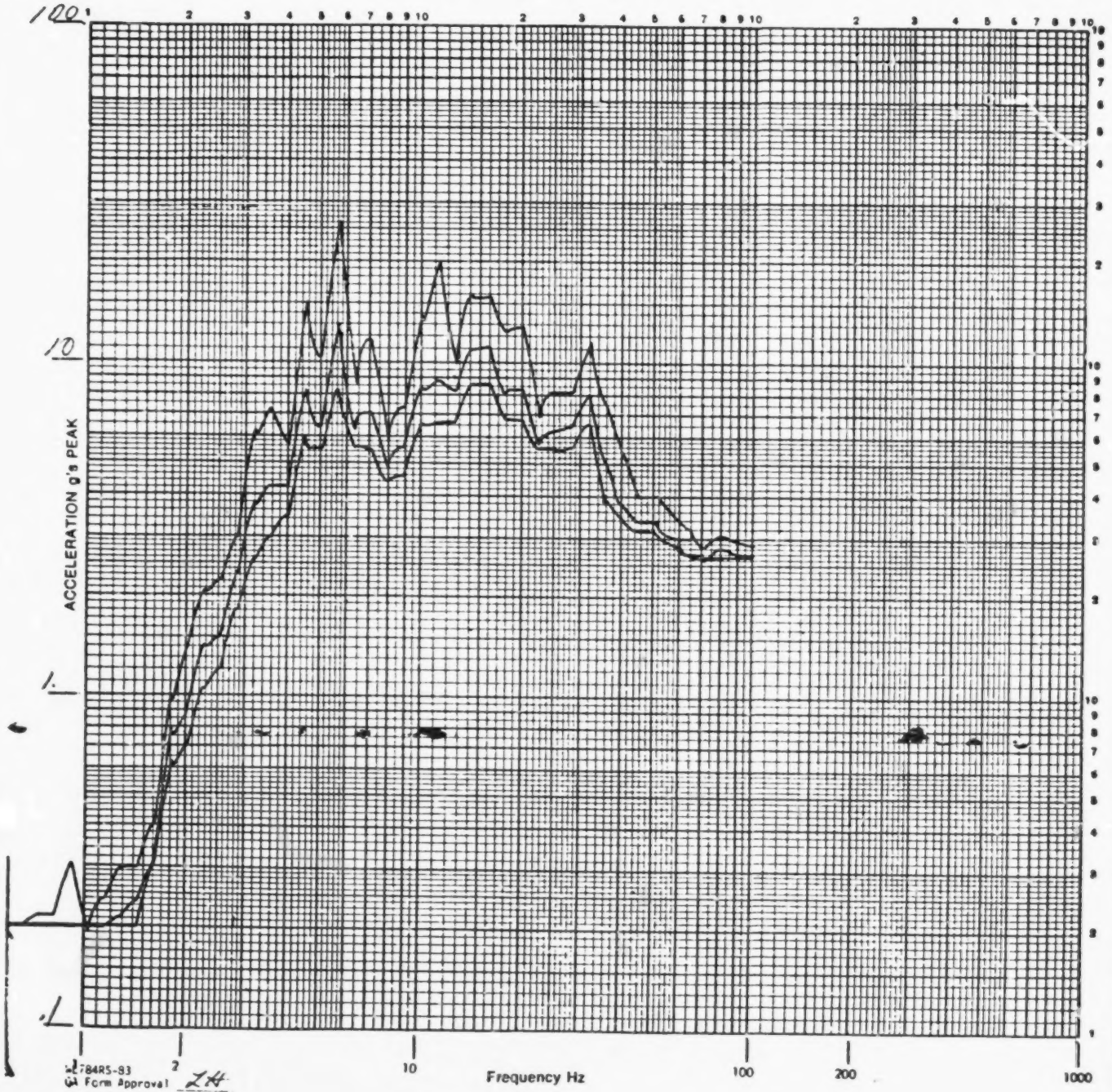
Accel. No. 12 Axis Y Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5,1,3 % Run No. 17

Operator GREENMAN Engineer

5th LEVEL 30HZ

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L Job No. 26447 Date 10-3-85

Specimen MOTOR CONTROL UNIT Axis of Test X-Y

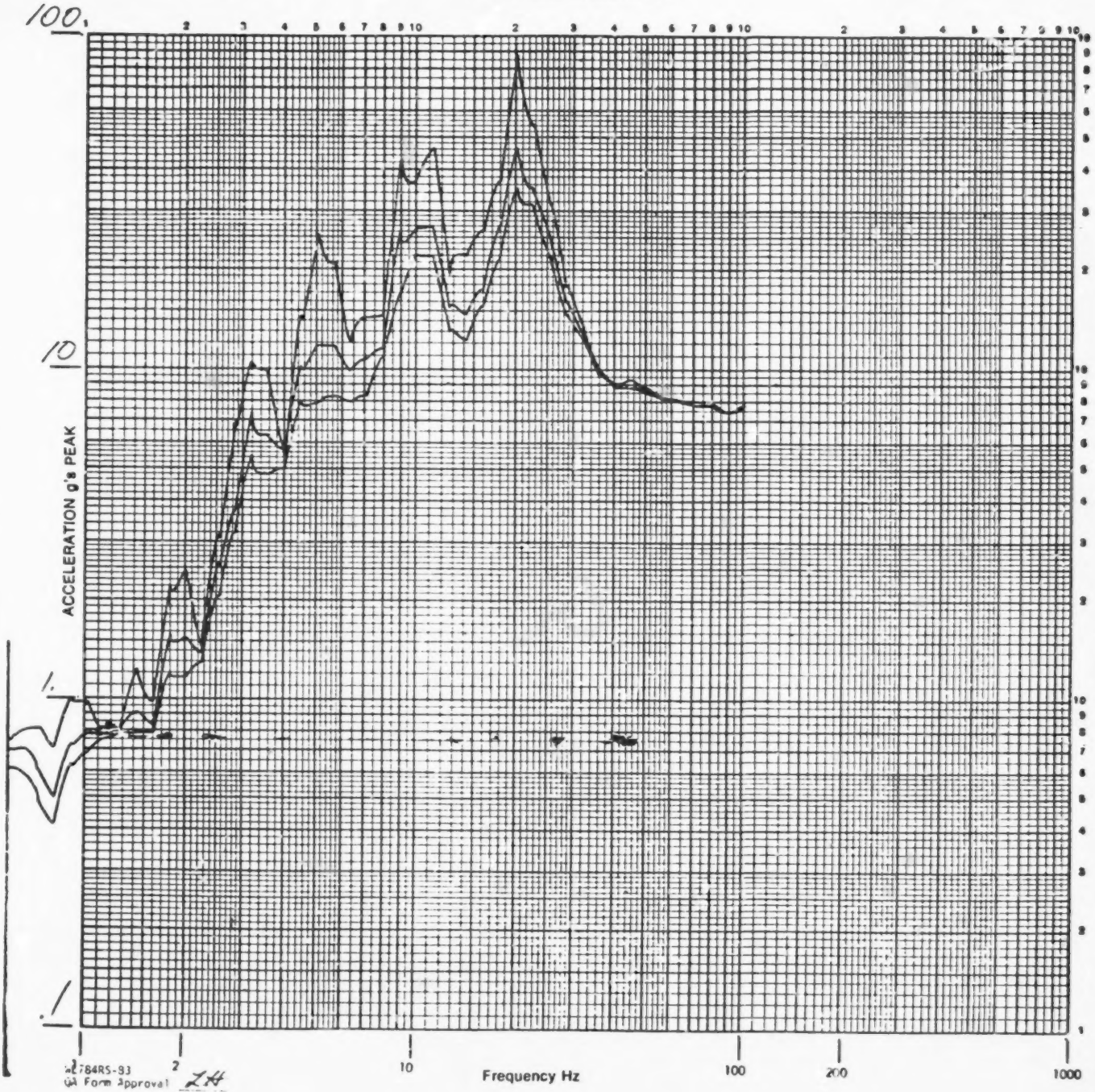
Accel. No. 13 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 4, 3 % Run No. 17

Operator GREENMAN Engineer

#5 TH LEVEL 30 HZ

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 10-3-85

Specimen MOTOR CONTROL Axis of Test X-Y

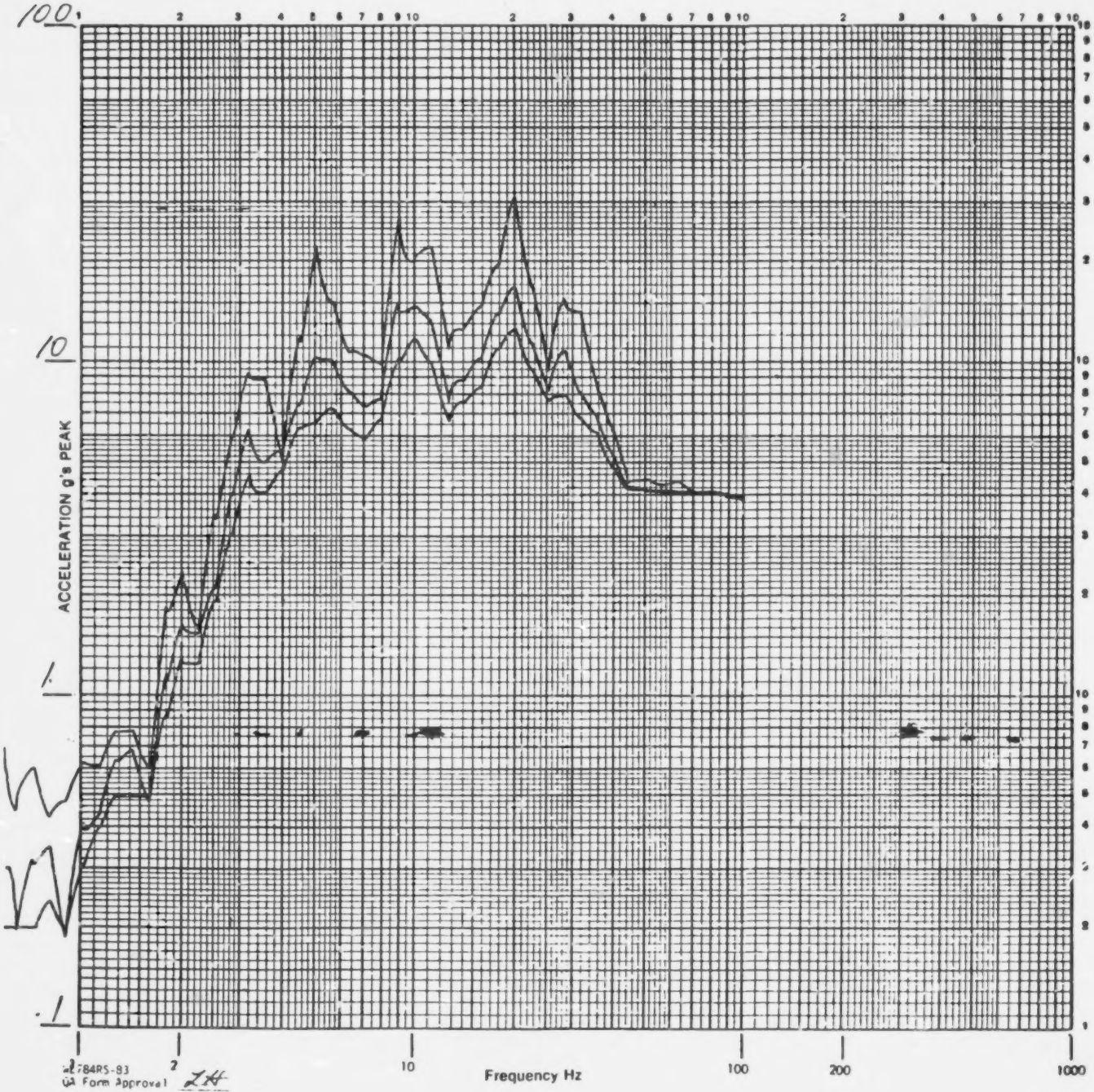
Accel. No. 14 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 17

Operator GREENMAN Engineer [signature]

5TH LEVEL 30 HZ

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 10-3-85

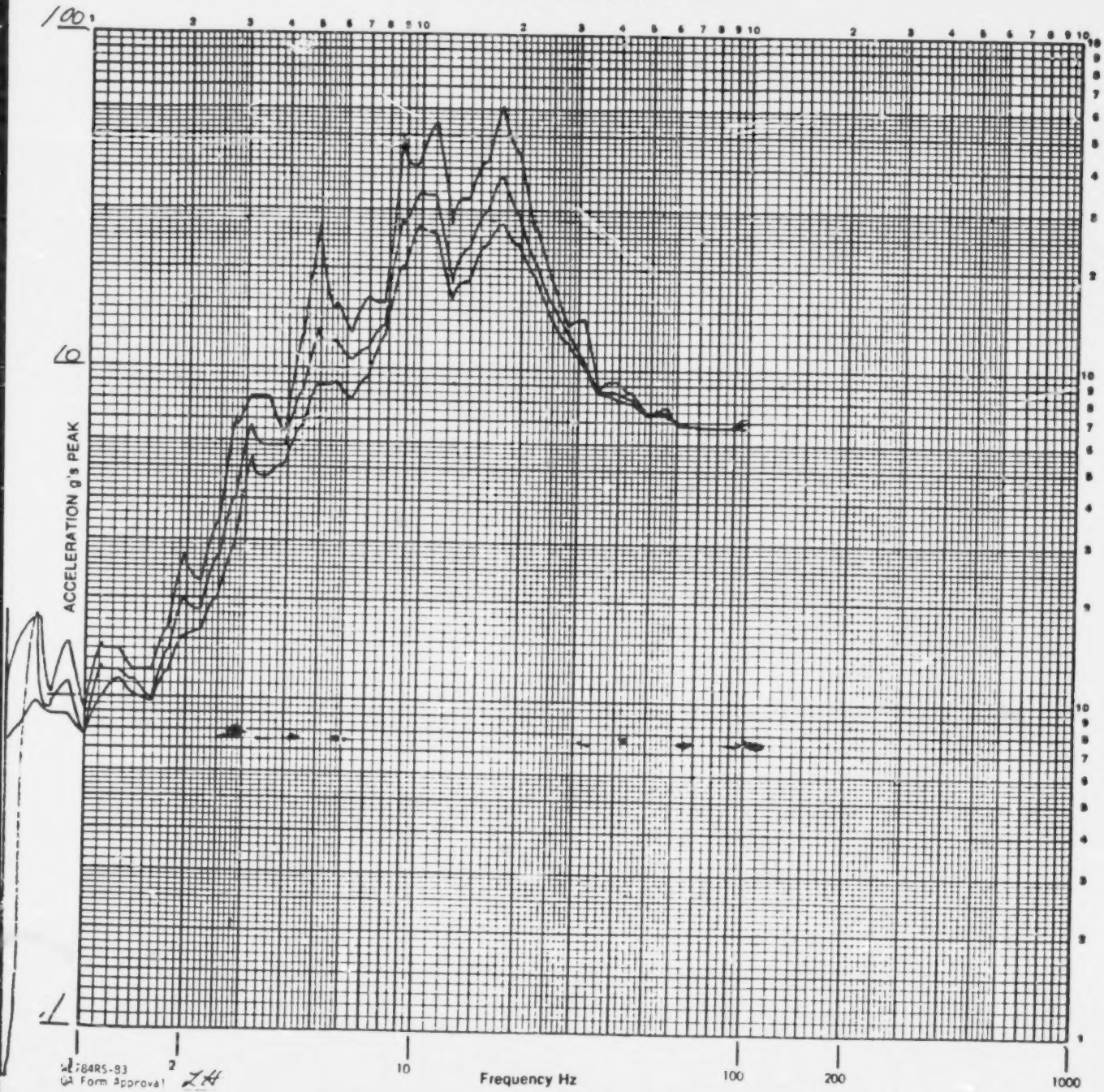
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 17 Axis X Control ( ) Response ( ) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 17

Operator GREIERMAN Engineer [illegible] 5th LEVEL 30 HZ

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 10-3-85

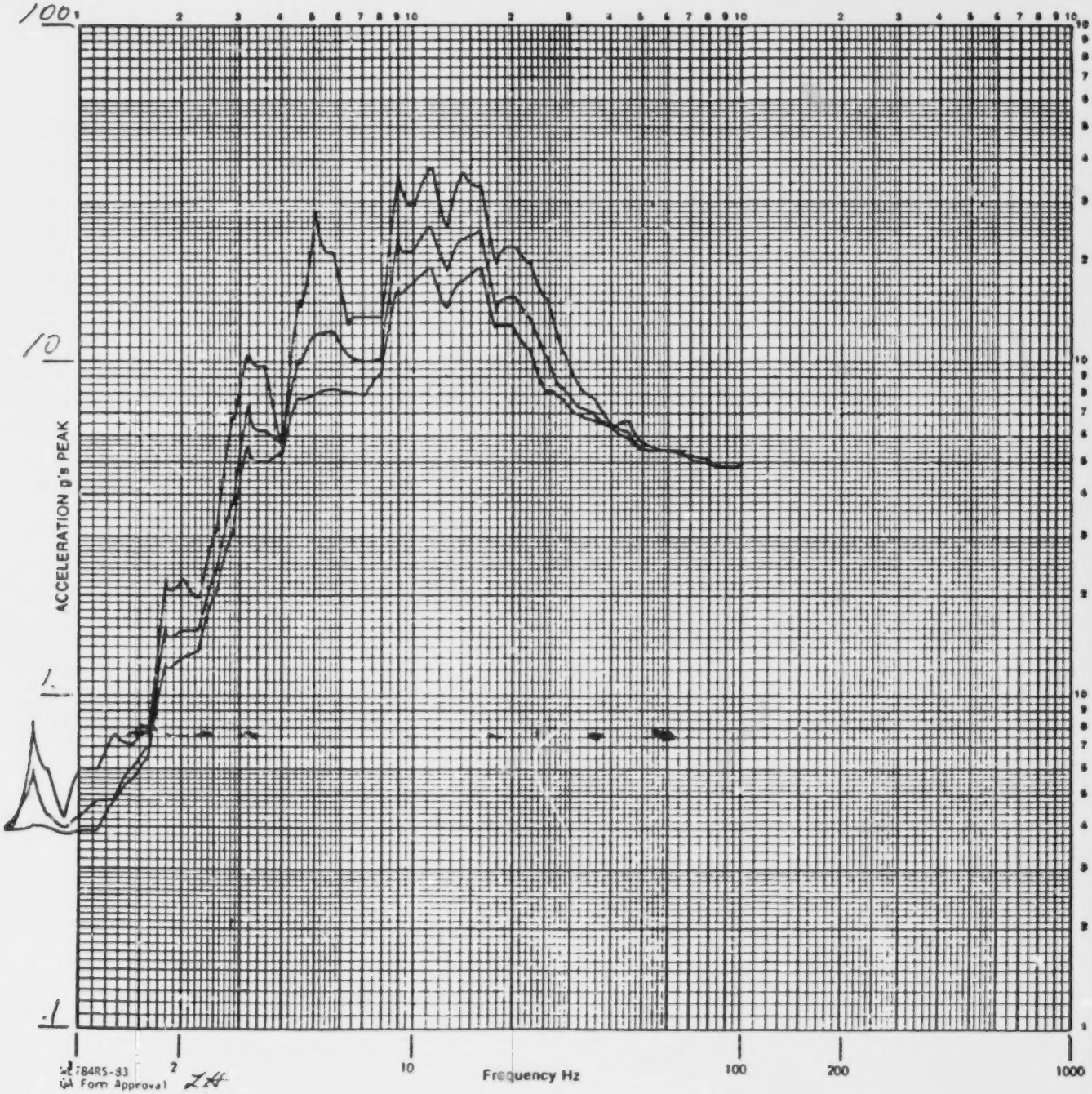
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 18 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 17

Operator GRETERMAN Engineer [illegible] 5th LEVEL 30 Hz

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

Specimen MOTOR CONTROL UNIT Axis of Test X-Y

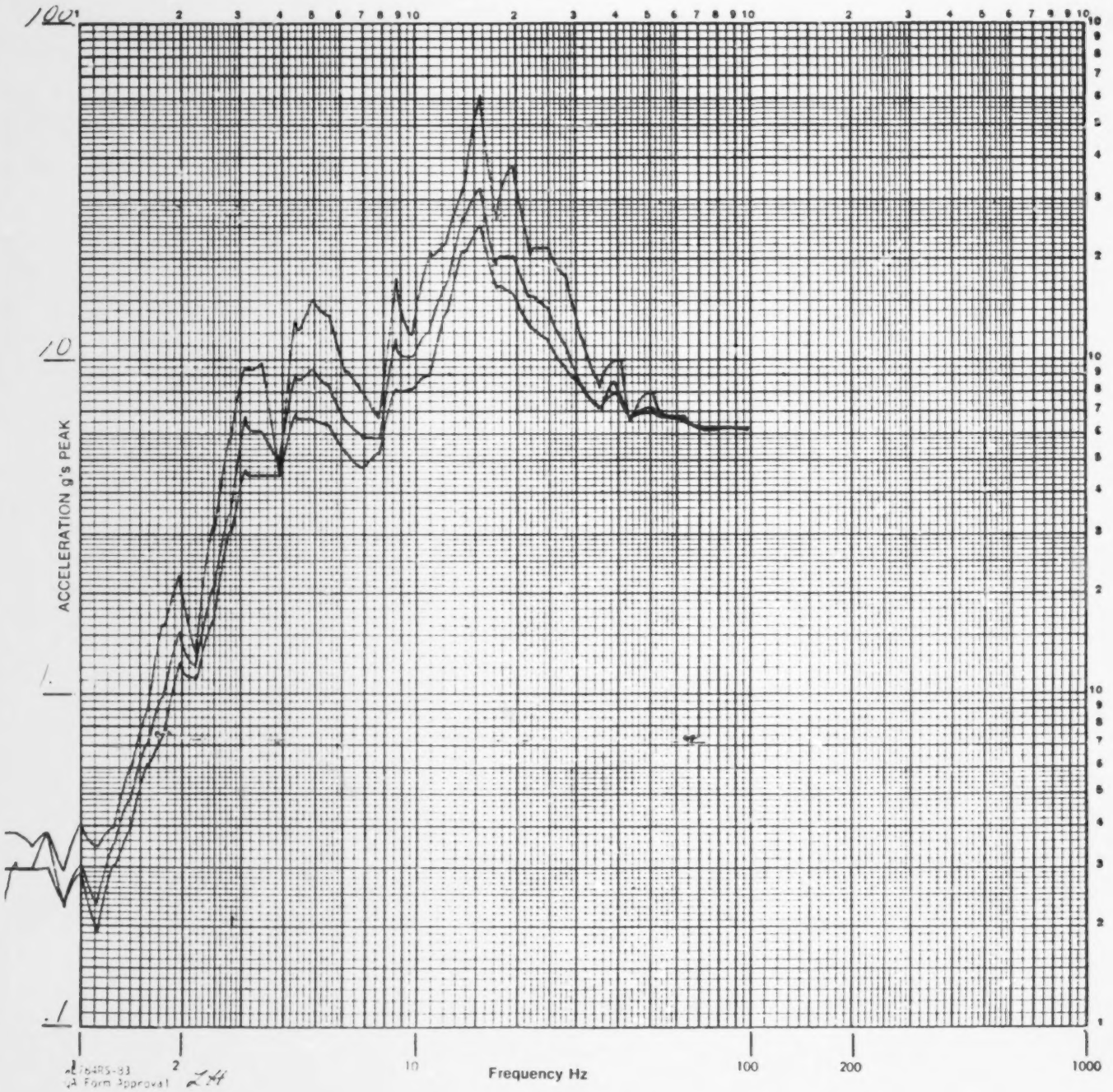
Accel. No. 19 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 4, 3 % Run No. 31

Operator GREELMAN Engineer

4B LEVEL 30 Hz

RESPONSE SPECTRUM



RUN 31

Four bolts per column with no top brace, 2.2g table ZPA

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CUSTOMER L. L. N. L. Job No. 26447 Date 10-25-85

Specimen MOTOR CONTROL CENTER Axis of Test X-Y

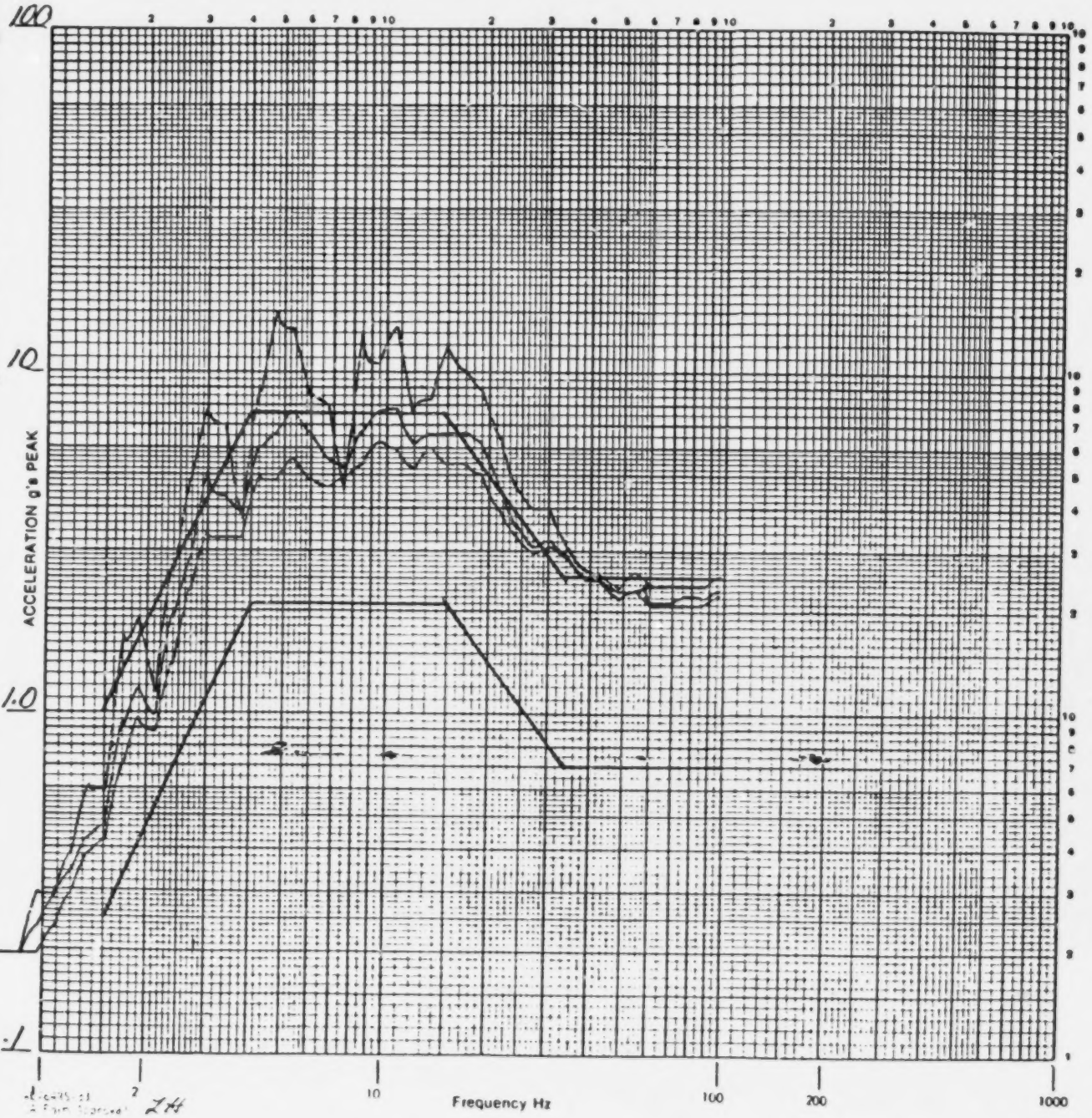
Accel. No. 1 Axis HORIZ Control (✓) Response ( ) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 31

Operator GREIERMAN Engineer

4B LEVEL 30 HZ

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

Specimen MOTOR CONTROL CENTER Axis of Test X-Y

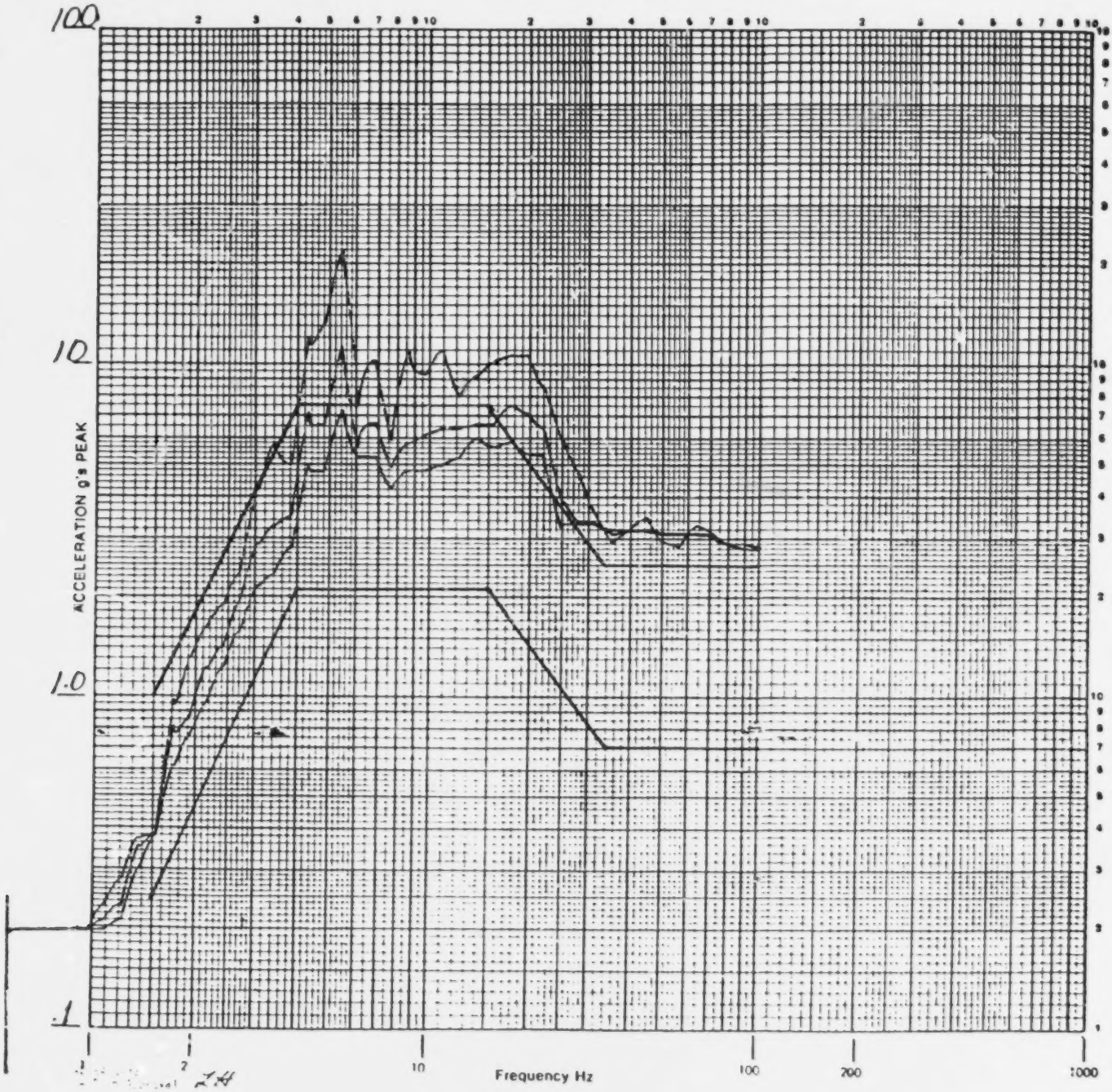
Accel. No. 2 Axis VERT Control (✓) Response ( ) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 3 % Run No. 31

Operator GREIFMAN Engineer [signature]

4th LEVEL 30 HZ

RESPONSE SPECTRUM



2%

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CUSTOMER L.L.NL. Job No. 26447 Date 10-25-85

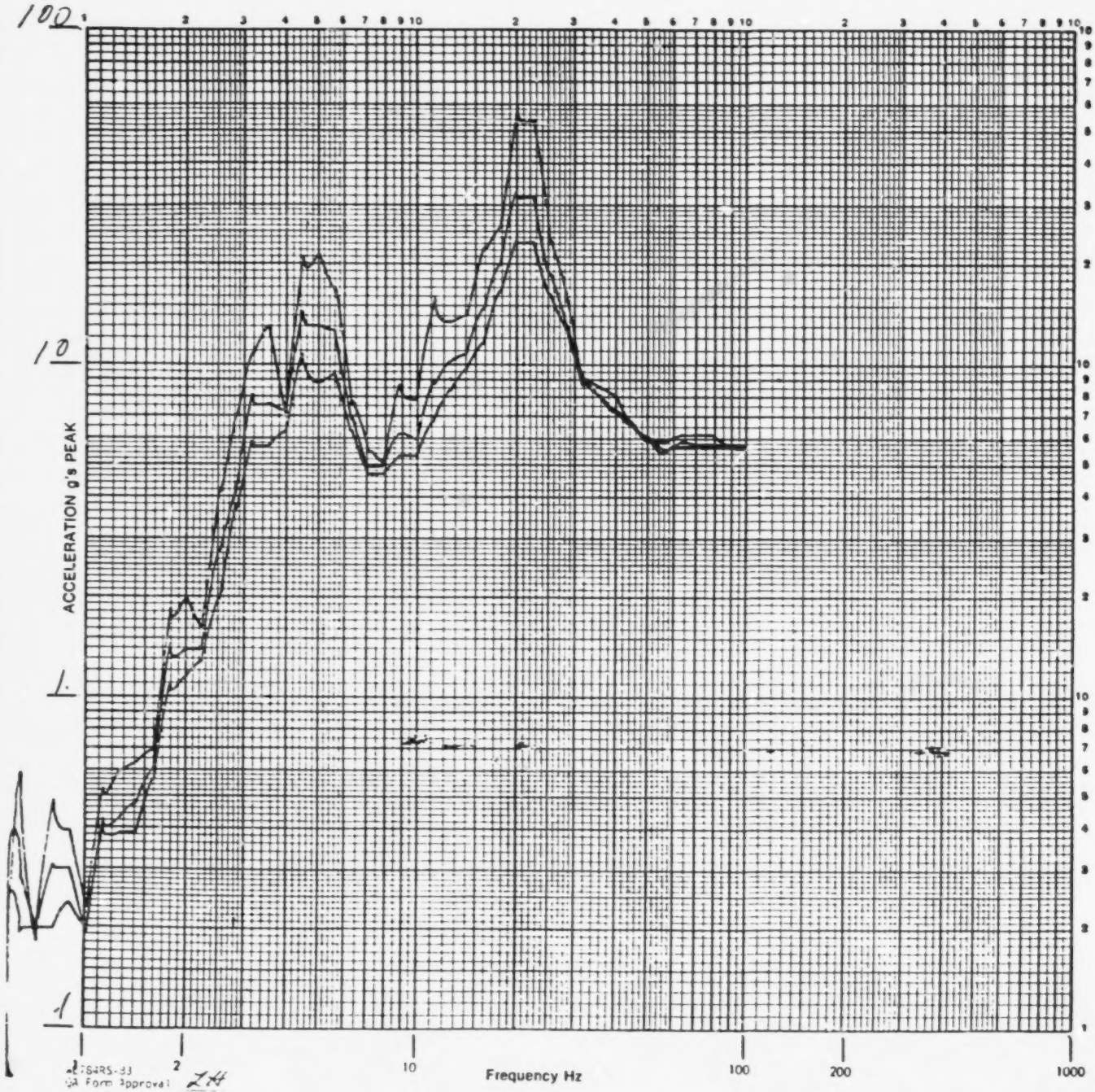
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 3 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 31

Operator GREIERMAN Engineer [signature] 4th LEVEL 30 HZ

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

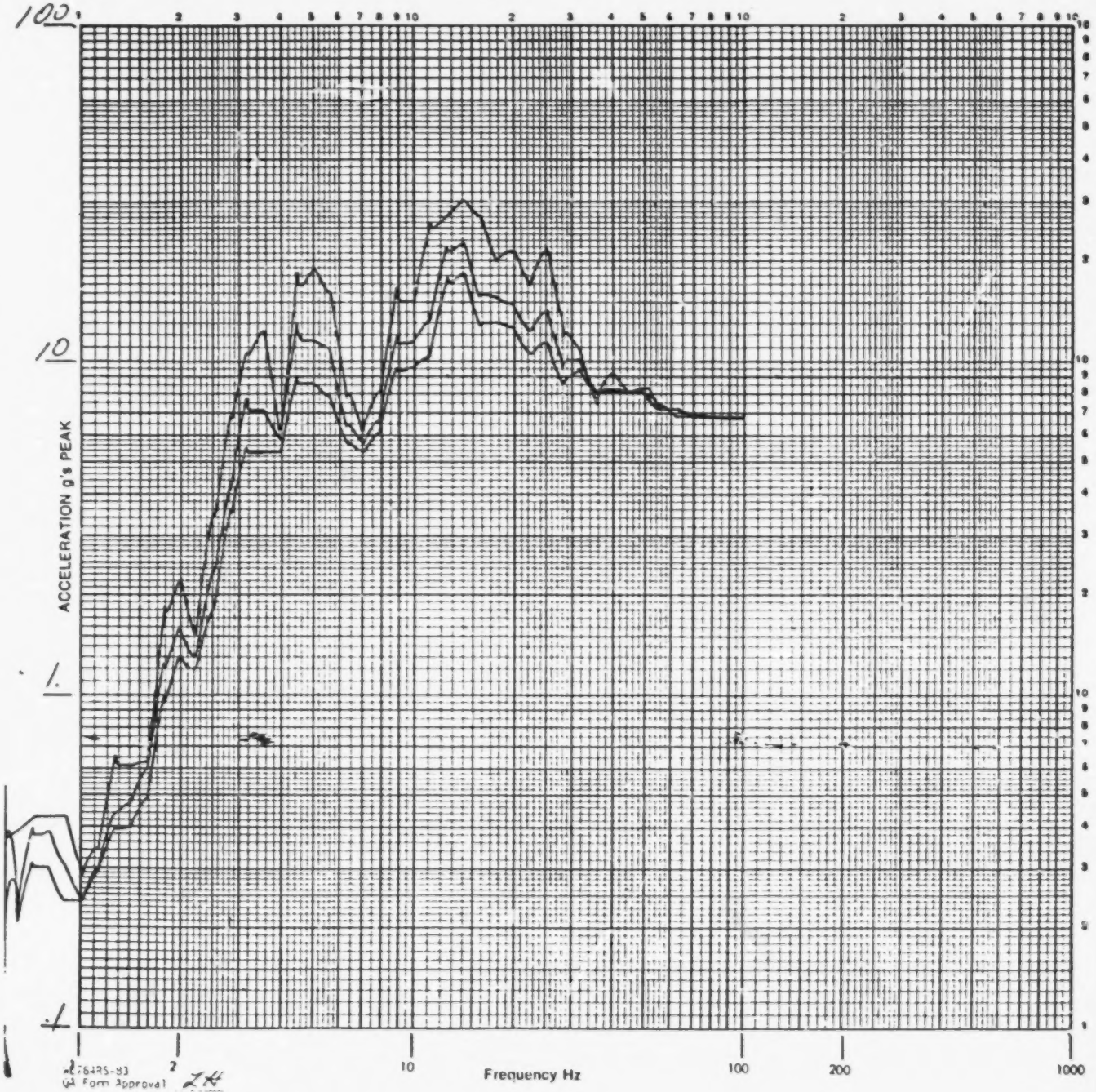
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 4 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 31

Operator GREIERMAN Engineer [signature] 4th LEVEL 30 HZ

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

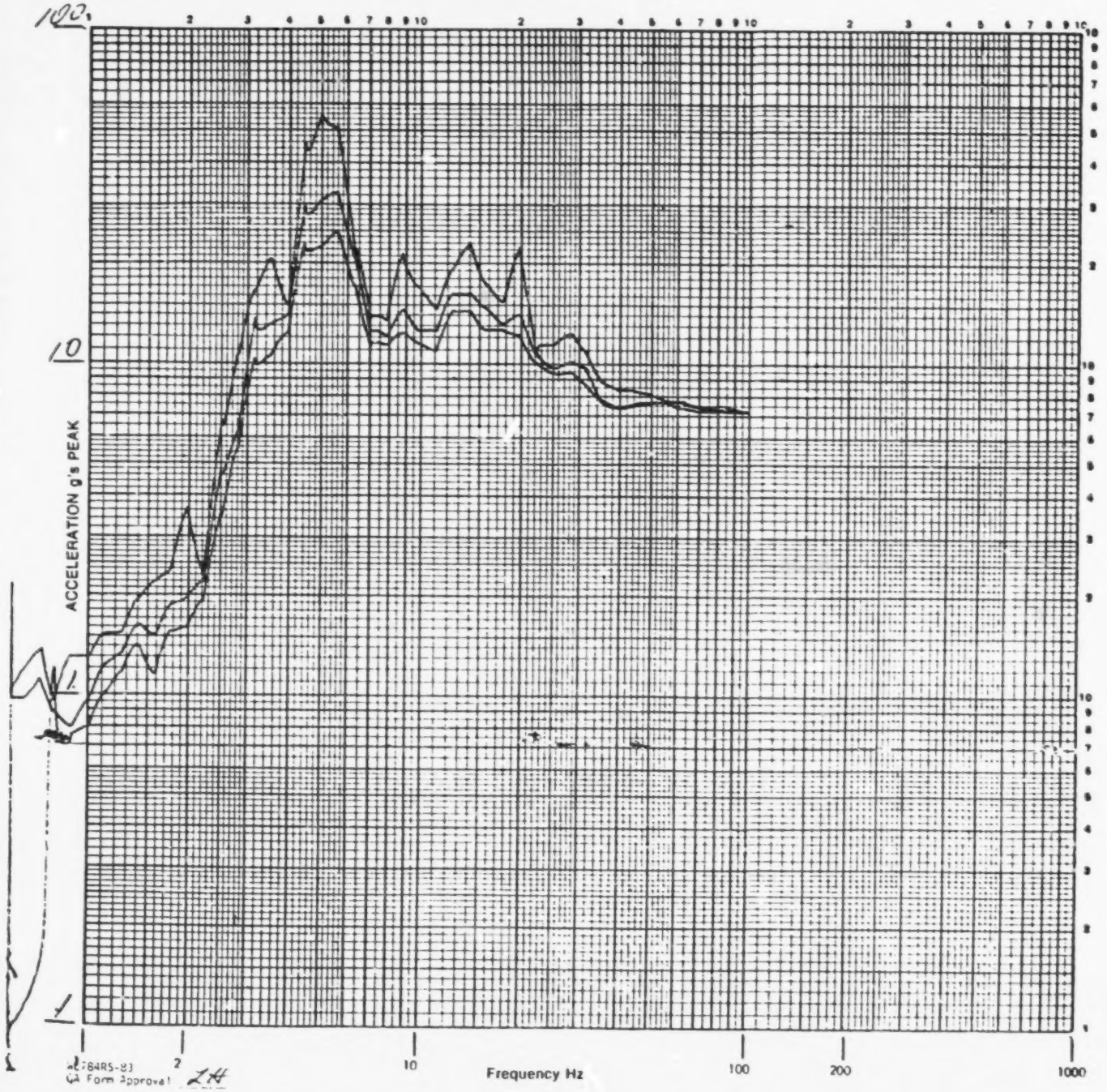
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 5 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 31

Operator G.P. FIERMAN Engineer [illegible] 4B LEVEL 30 Hz

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

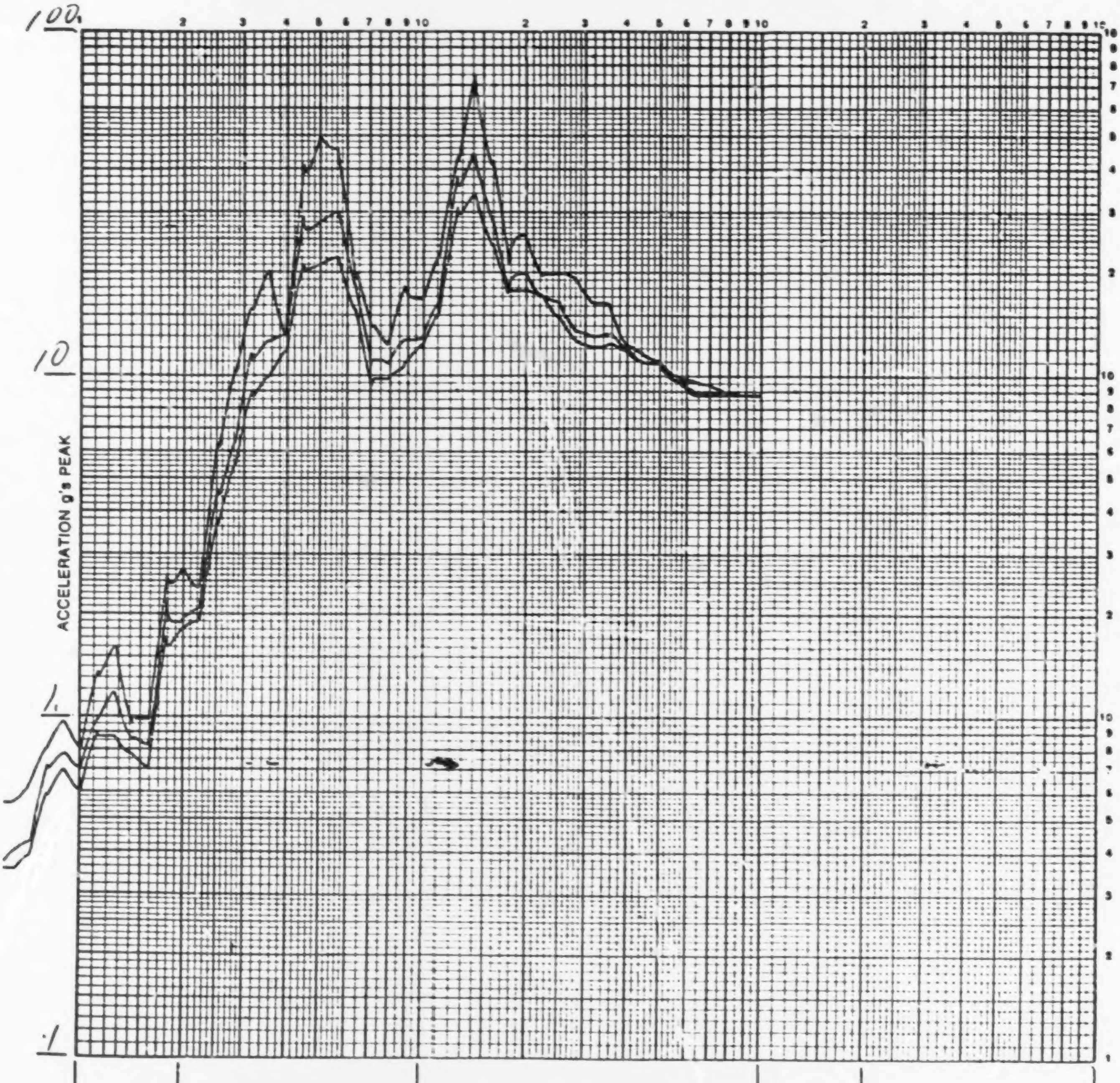
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 8 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 31

Operator GRETERMAN Engineer [illegible] 4B LEVEL 30 HZ

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

Specimen MOTOR CONTROL UNIT Axis of Test X-Y

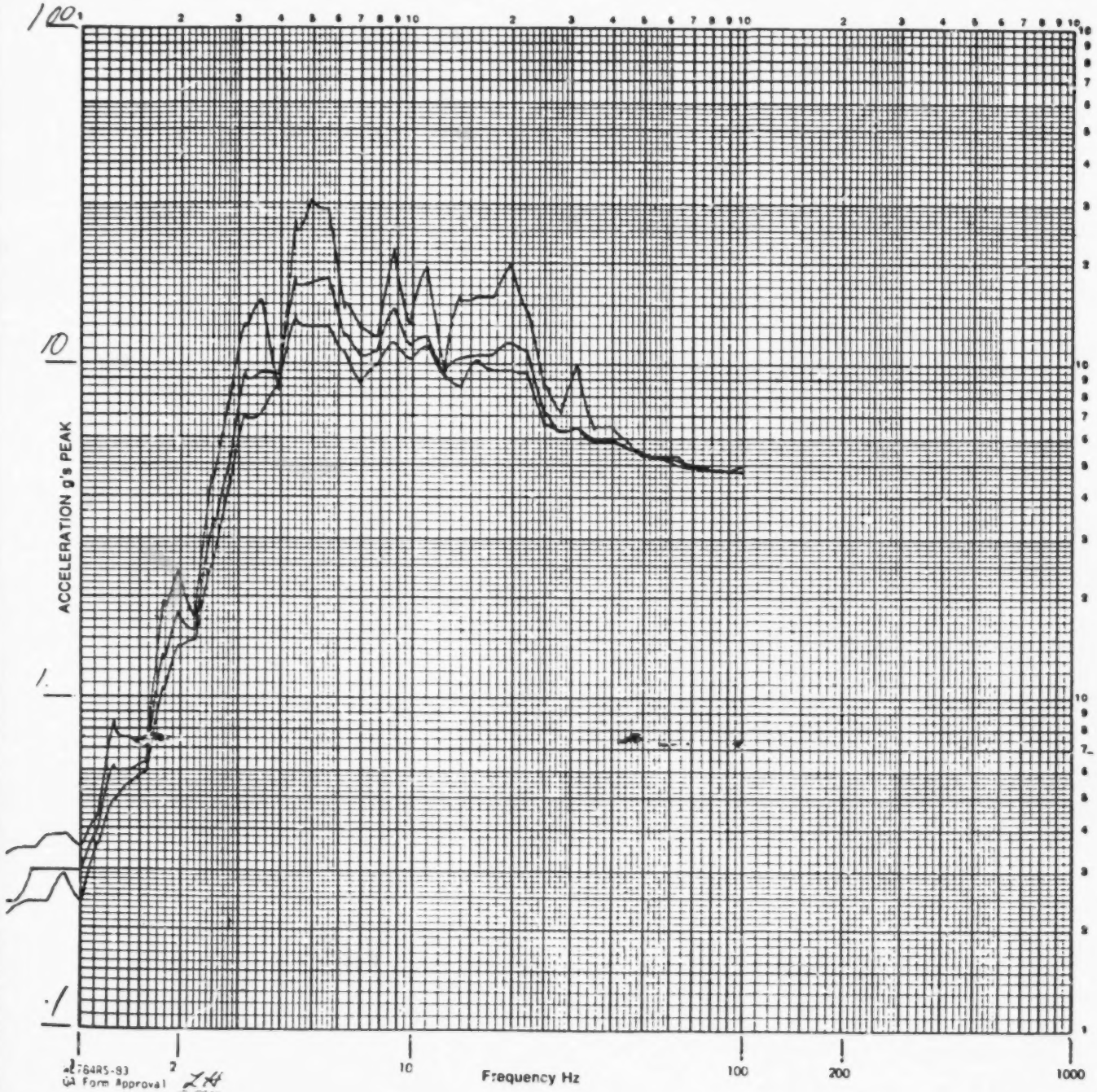
Accel. No. 9 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 4, 3 % Run No. 31

Operator GREENMAN Engineer

4TH LEVEL 30 HZ

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 25447 Date 10-25-85

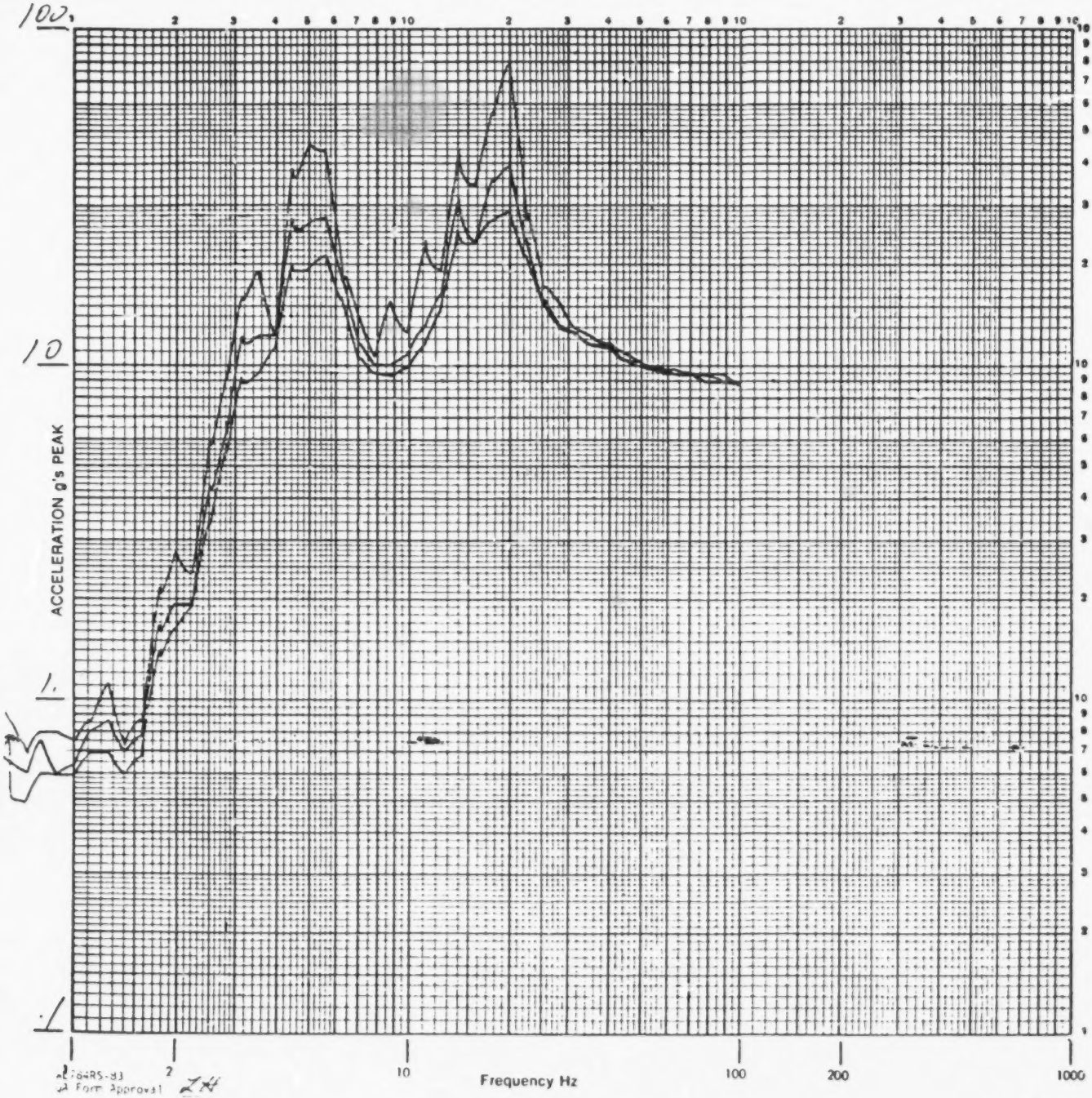
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 10 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 31

Operator GRETERMAN Engineer [illegible] 4TH LEVEL 30 Hz

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

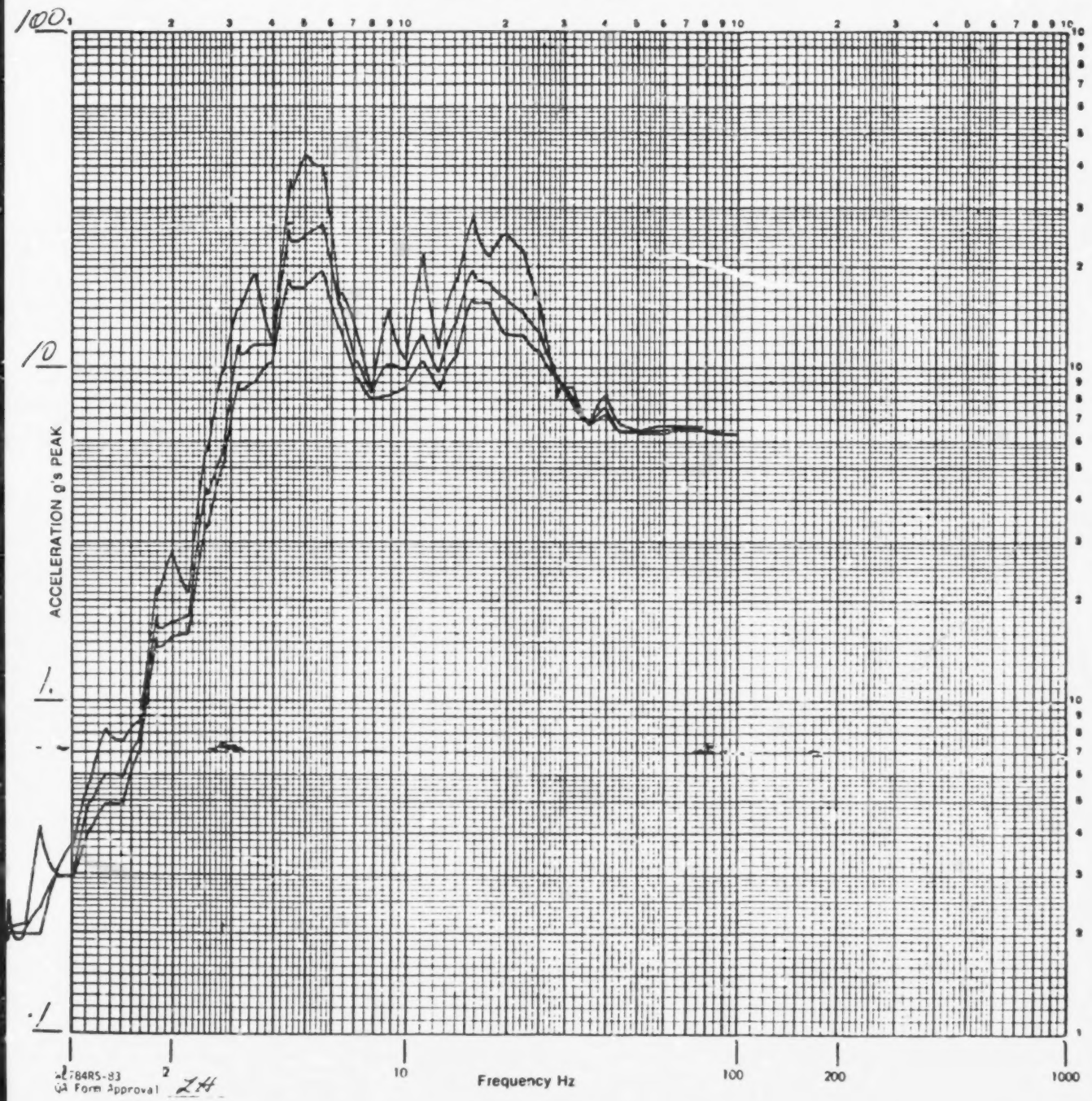
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 11 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5,1,3 % Run No. 31

Operator GREIERMAN Engineer [illegible] 4B LEVEL 30 Hz

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

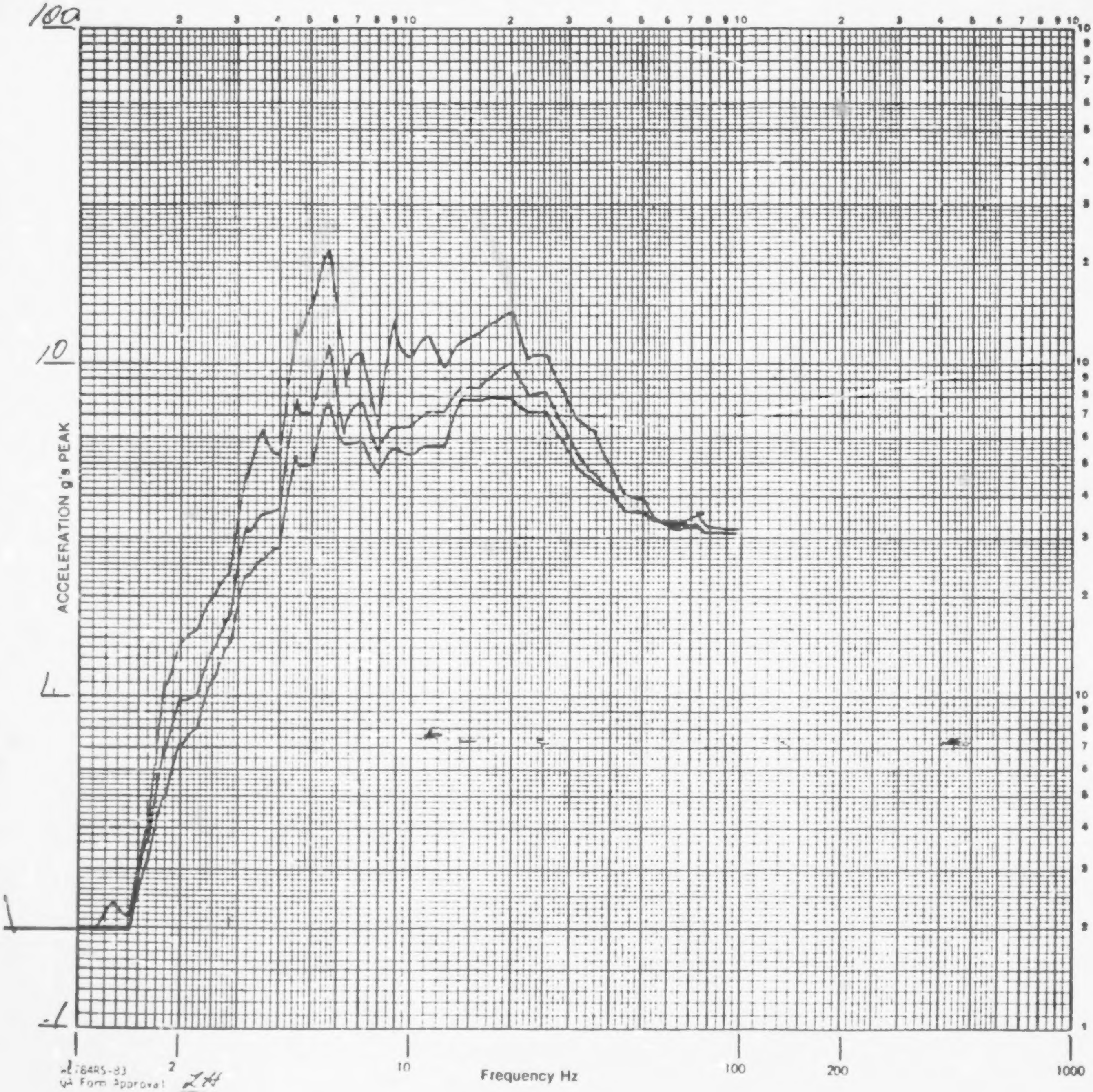
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 13 Axis Y Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 31

Operator Breitermann Engineer [signature] 4th Level 30 Hz

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

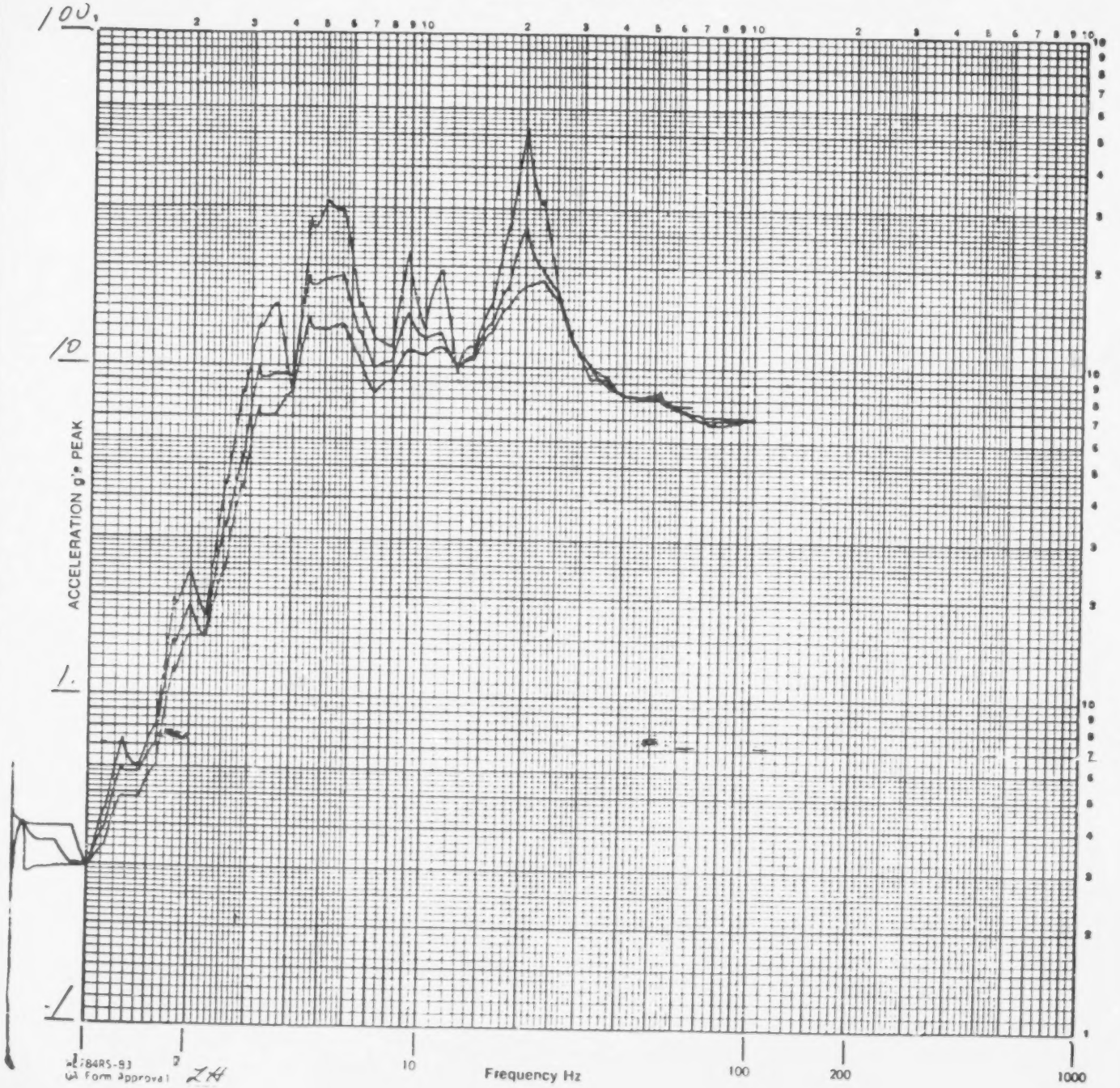
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 13 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 31

Operator GREIERMAN Engineer [signature] 4th LEVEL 30 HZ

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

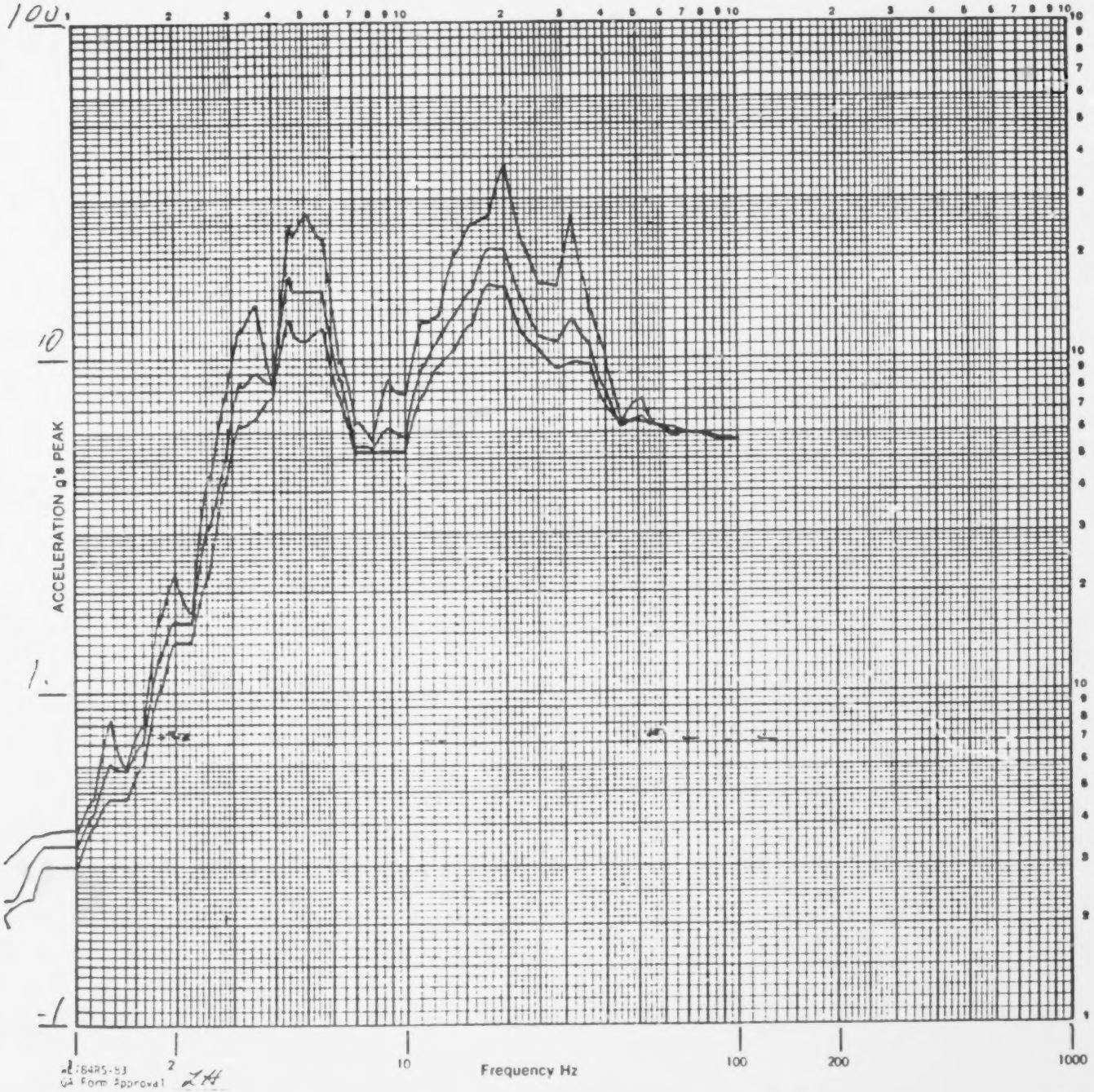
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 14 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 31

Operator GREIERMAN Engineer [signature] 4th LEVEL 30 Hz

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

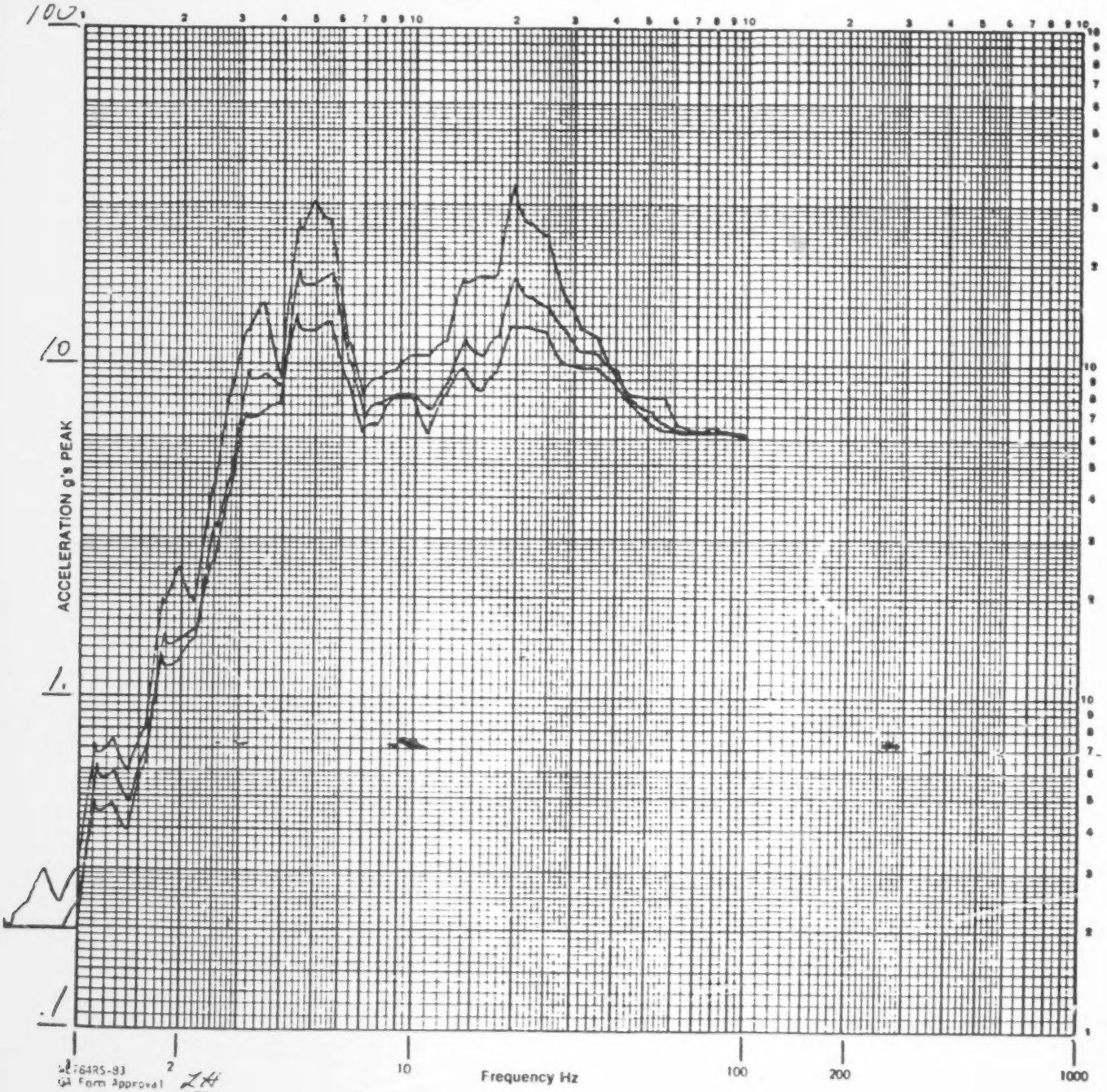
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 15 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 31

Operator GRETERMAN Engineer [signature] 4 B LEVEL 30 HZ

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

Specimen MOTOR CONTROL UNIT Axis of Test X-Y

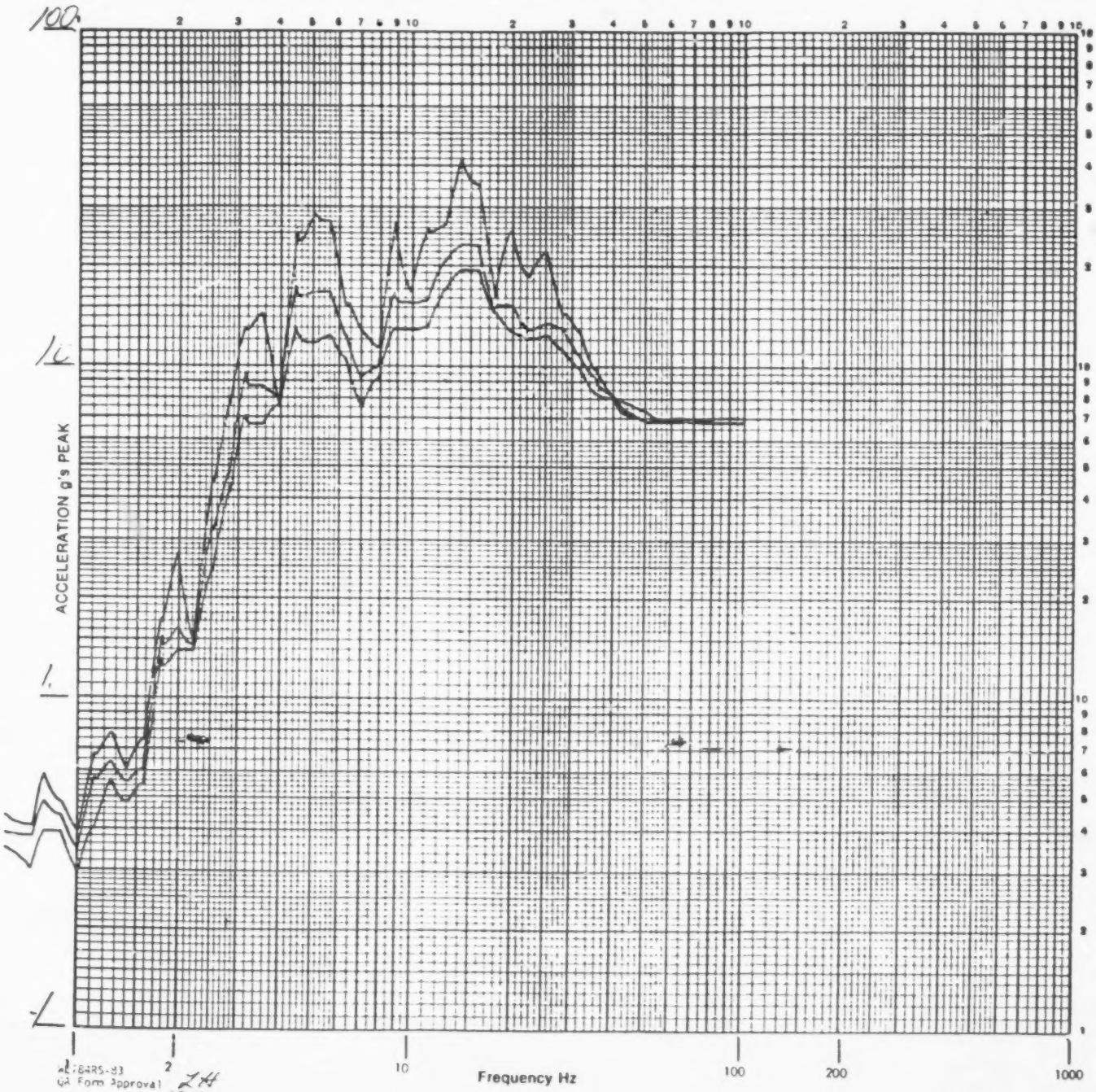
Accel. No. 16 Axis X Control ( ) Response ( ) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5,4,3 % Run No. 31

Operato BRETERNITZ Engineer

4TH LEVEL 30 HZ

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

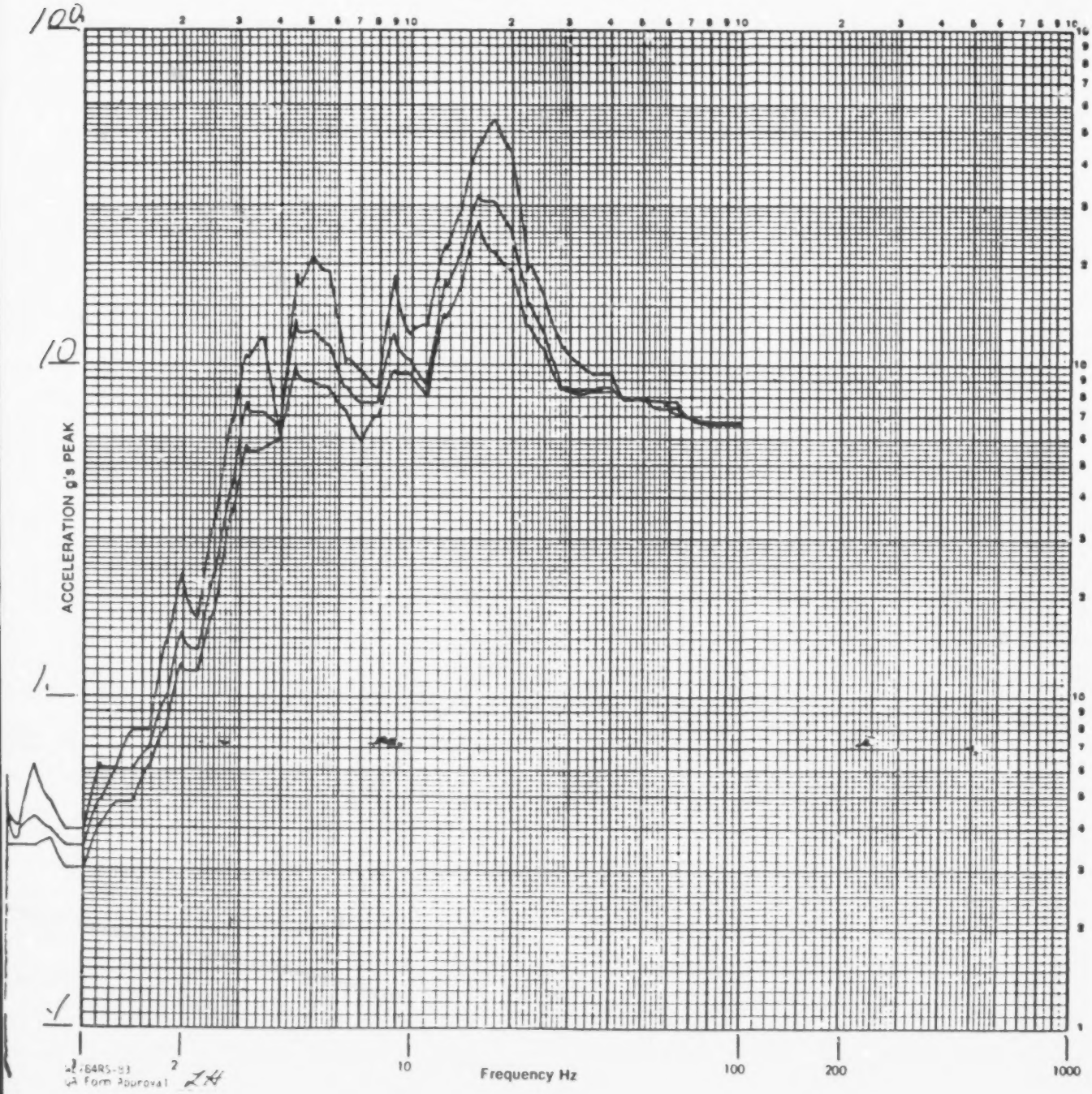
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 17 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 31

Operator GREIERMAN Engineer [signature] 4th LEVEL 30 HZ

RESPONSE SPECTRUM



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CUSTOMER L.C.W.L. Job No. 26447 Date 10-25-85

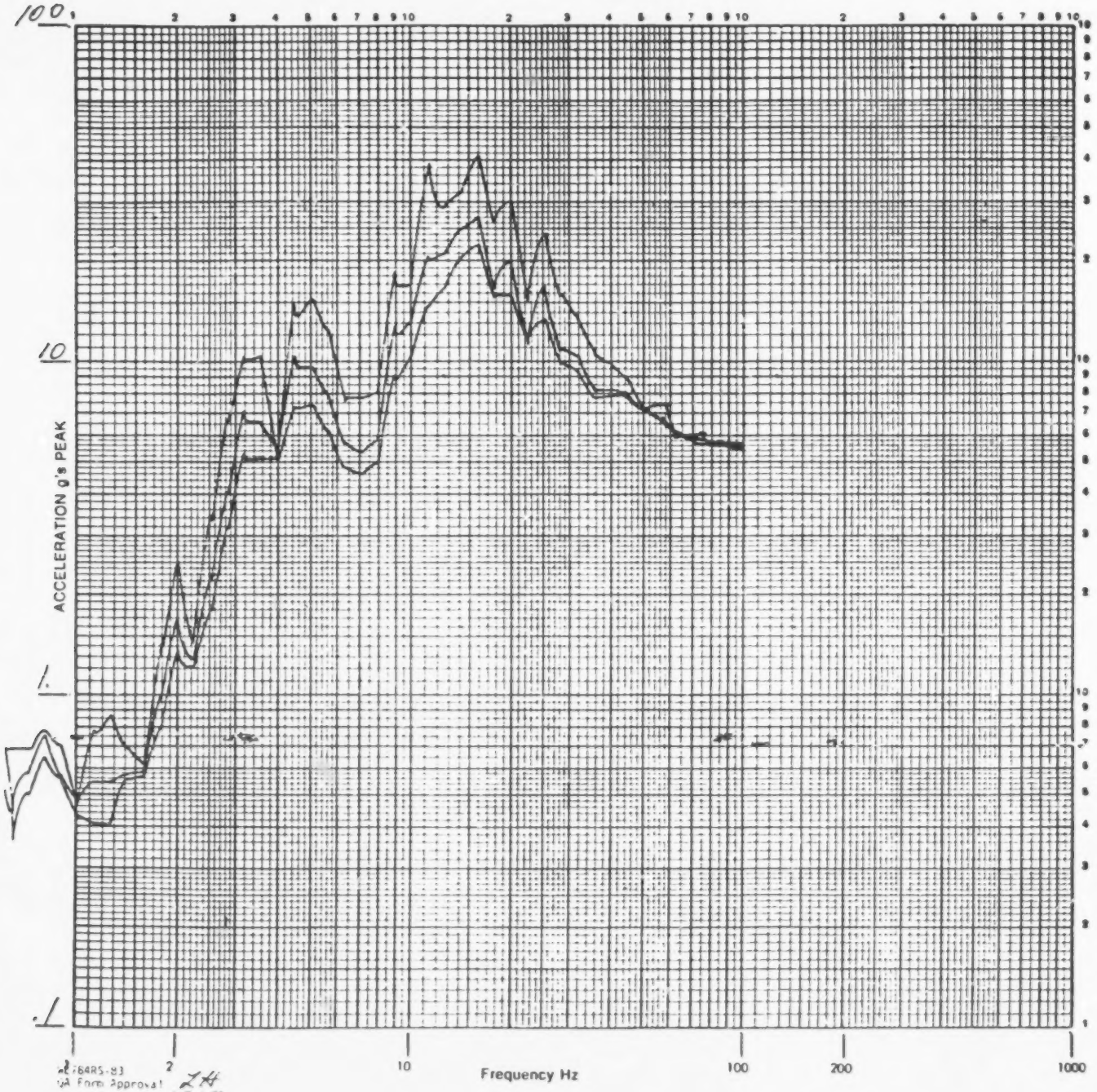
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 18 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 31

Operator GREIERMAN Engineer [signature] 4th Level 30Hz

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 10-25-85

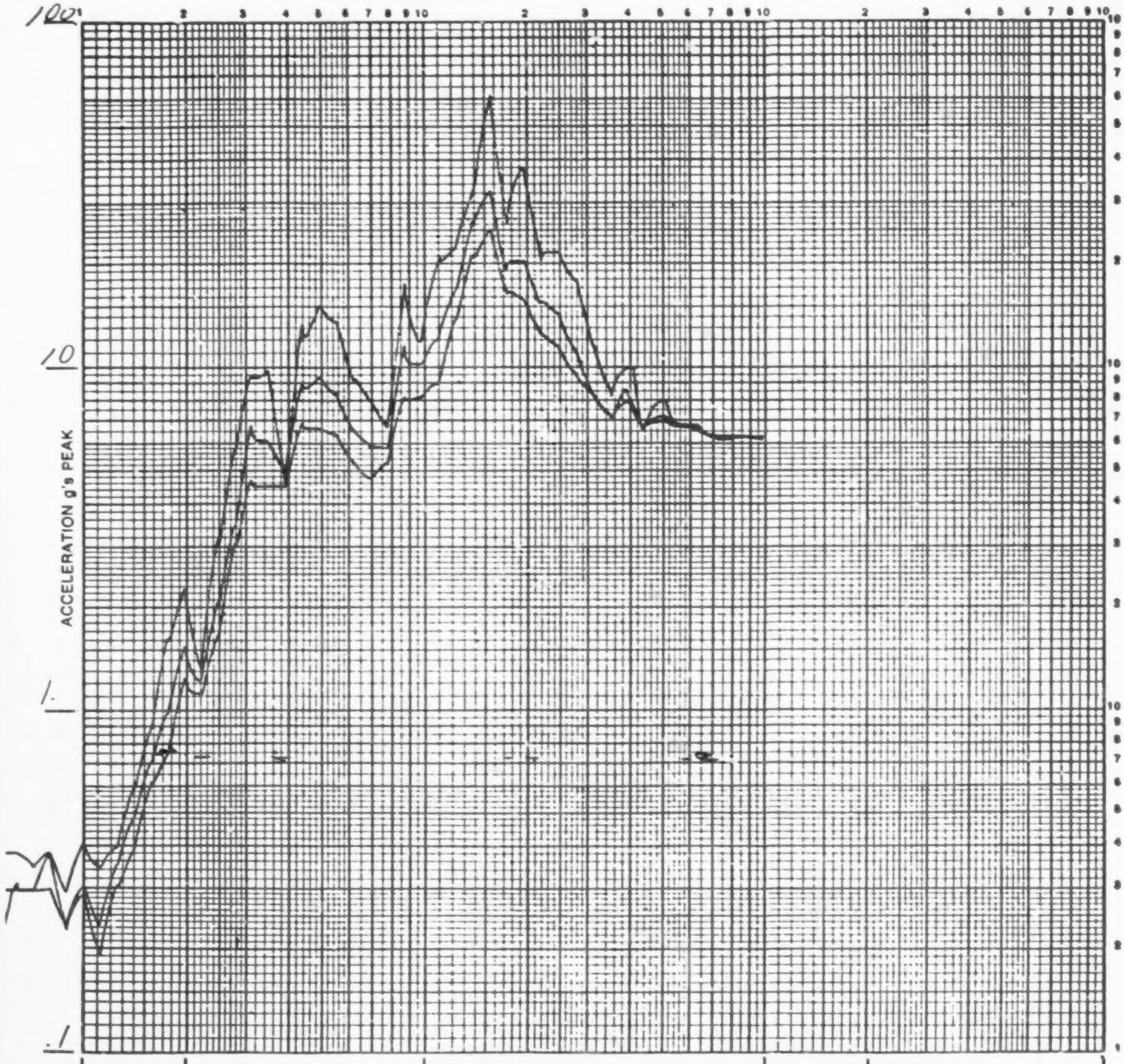
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 17 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5,4,3 % Run No. 31

Operator GREIERMAN Engineer [signature] 4B LEVEL 30 HZ

RESPONSE SPECTRUM



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RUN 46

Two bolts per column with no top brace, 2.5g table ZPA

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CUSTOMER L. L. N. L. Job No. 26447 Date 12-5-85

Specimen MOTOR CONTROL CENTER Axis of Test X-Y

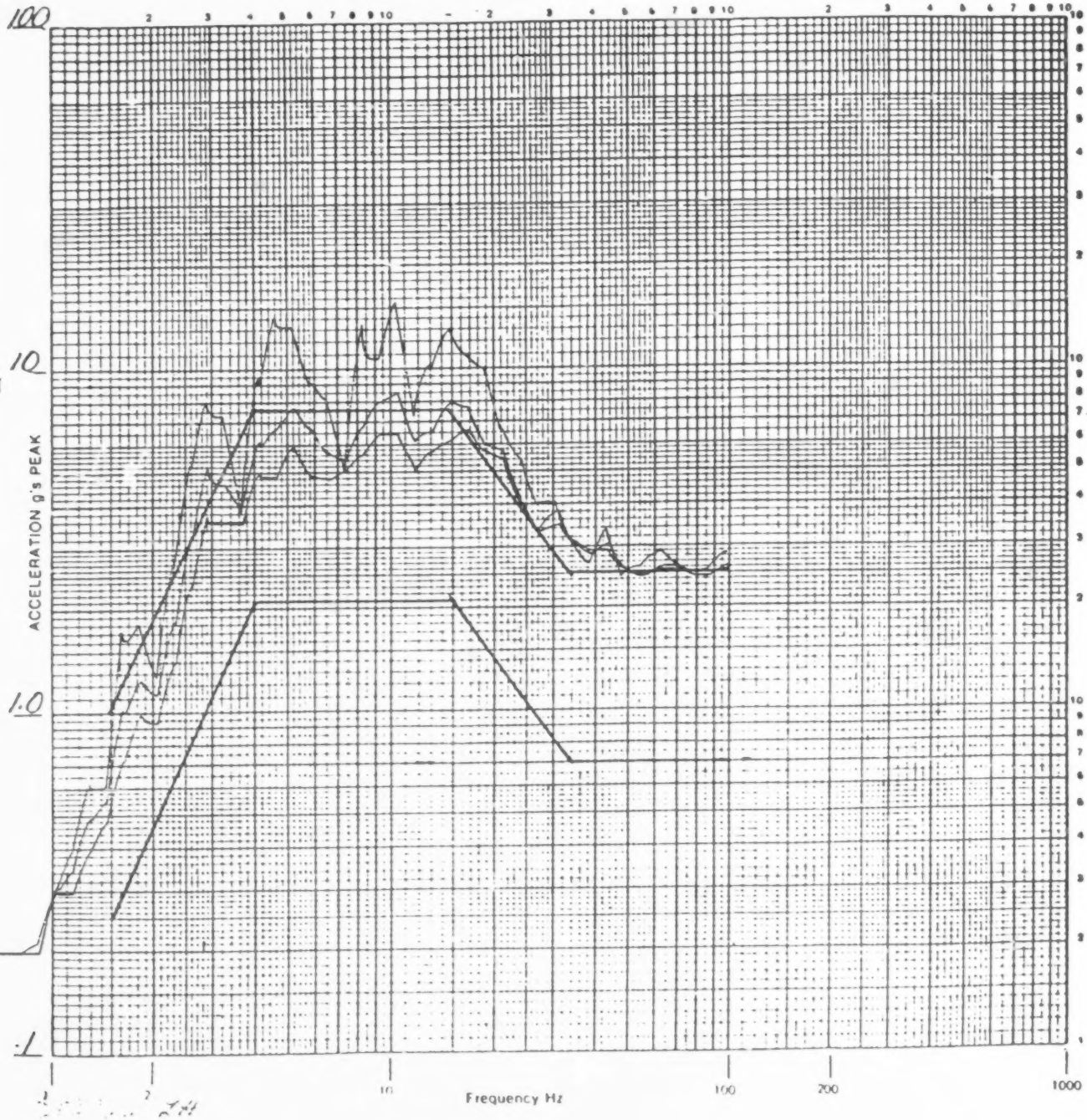
Accel. No. 1 Axis HORIZ Control ( ) Response ( ) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 46

Operator GREIERMAN Engineer

5% LEVEL 30 HZ

RESPONSE SPECTRUM



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CUSTOMER L. L. N. L. Job No. 26447 Date 12-5-85

Specimen MOTOR CONTROL CENTER Axis of Test X-Y

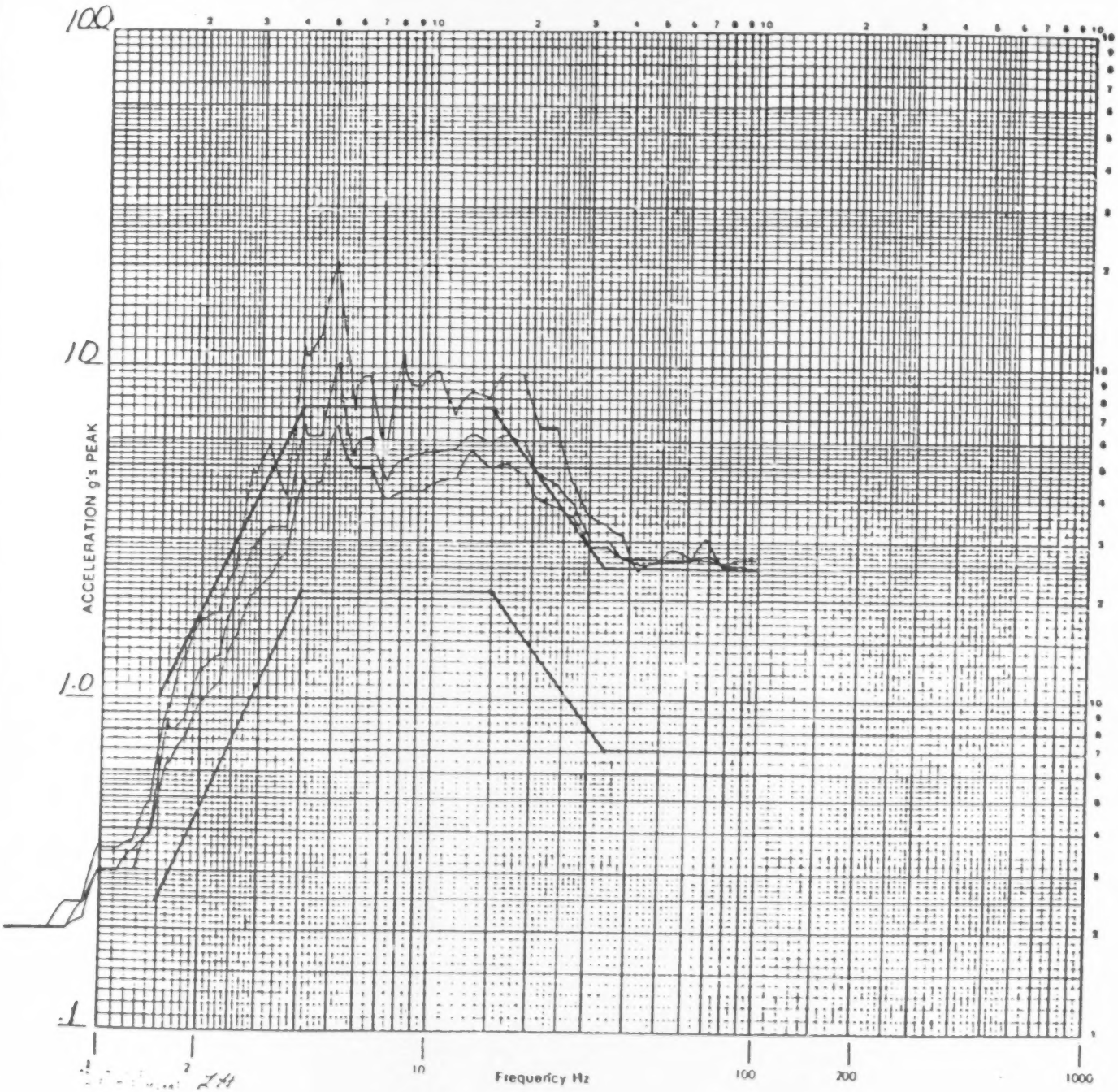
Accel No 2 Axis VERT Control ( ) Response ( ) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 46

Operator GREIFERMAN Engineer

5TH LEVEL 30 Hz

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 12-5-85

Specimen MOTOR CONTROL UNIT Axis of Test X-Y

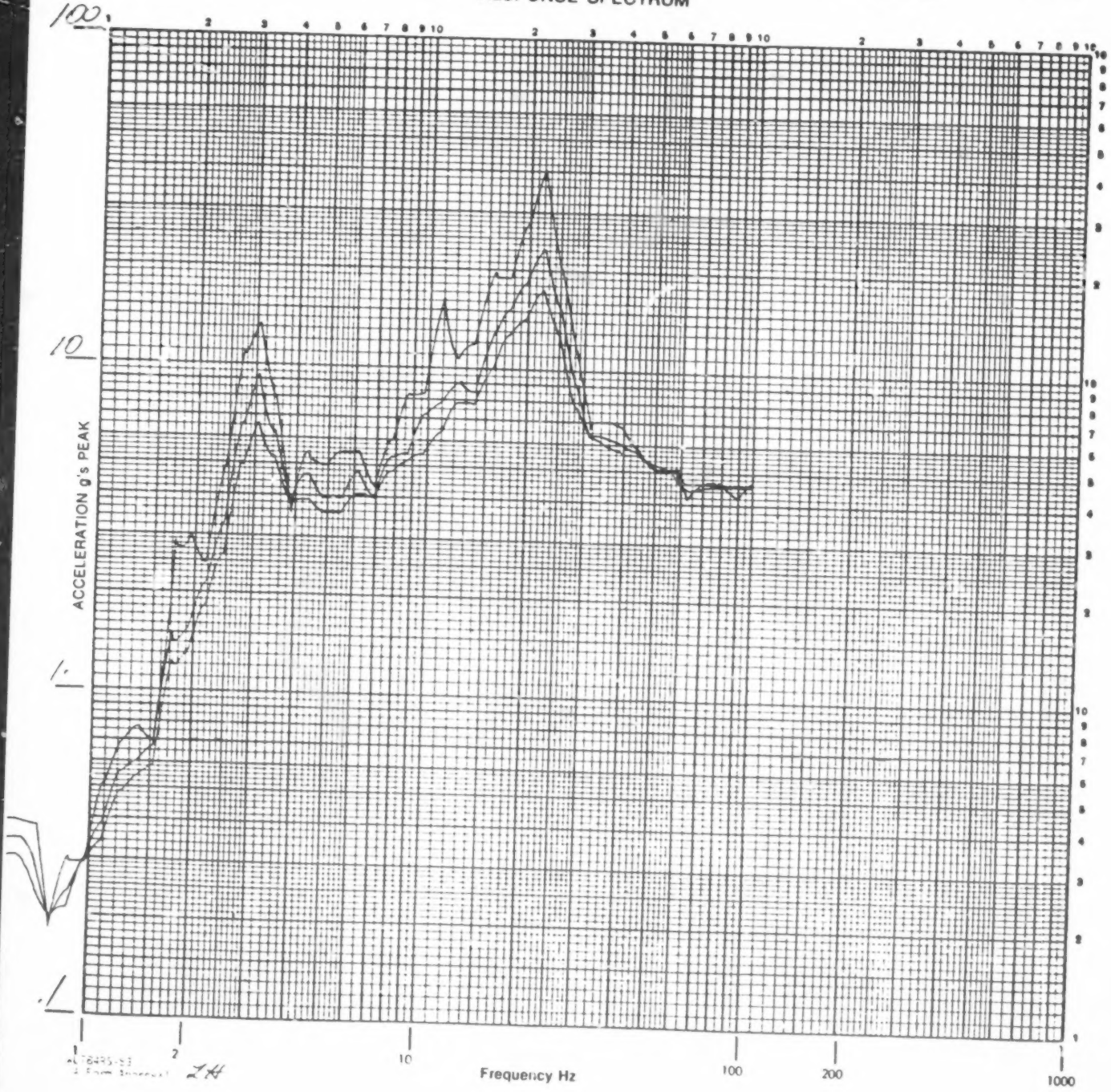
Accel. No. 3 Axis X Control ( ) Response ( ) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 46

Operator GREENEMAN Engineer [signature]

5TH LEVEL 30HZ

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 12-5-85

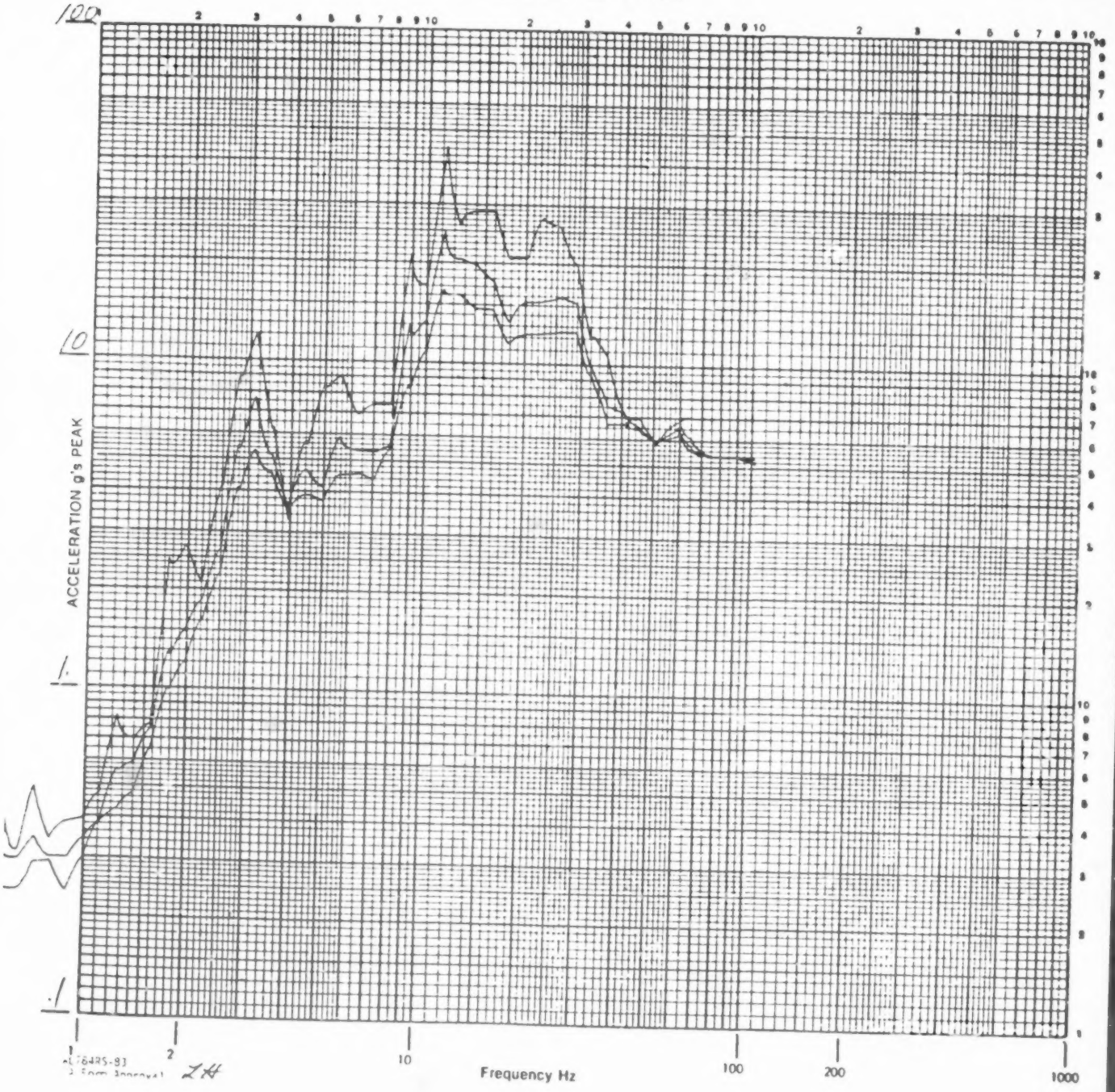
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 4 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 46

Operator GREIERMAN Engineer [signature] 5th LEVEL 30 HZ

RESPONSE SPECTRUM



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CUSTOMER L. L. N. L. Job No. 26447 Date 12-5-85

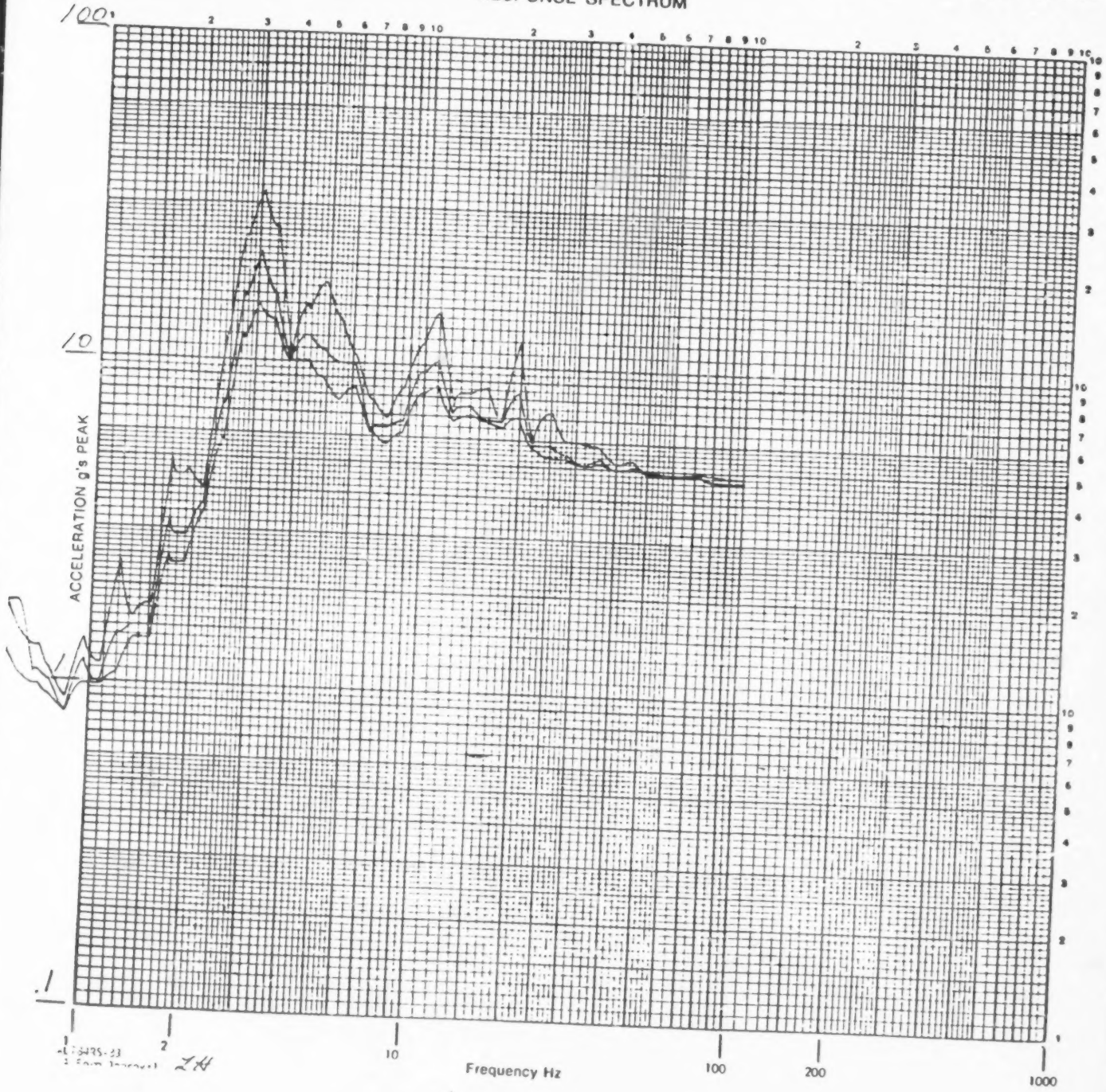
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 5 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 46

Operator [illegible] Engineer [illegible] 5 B Level 30Hz Lo-Pass

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 12-5-85

Specimen MOTOR CONTROL UNIT Axis of Test X-Y

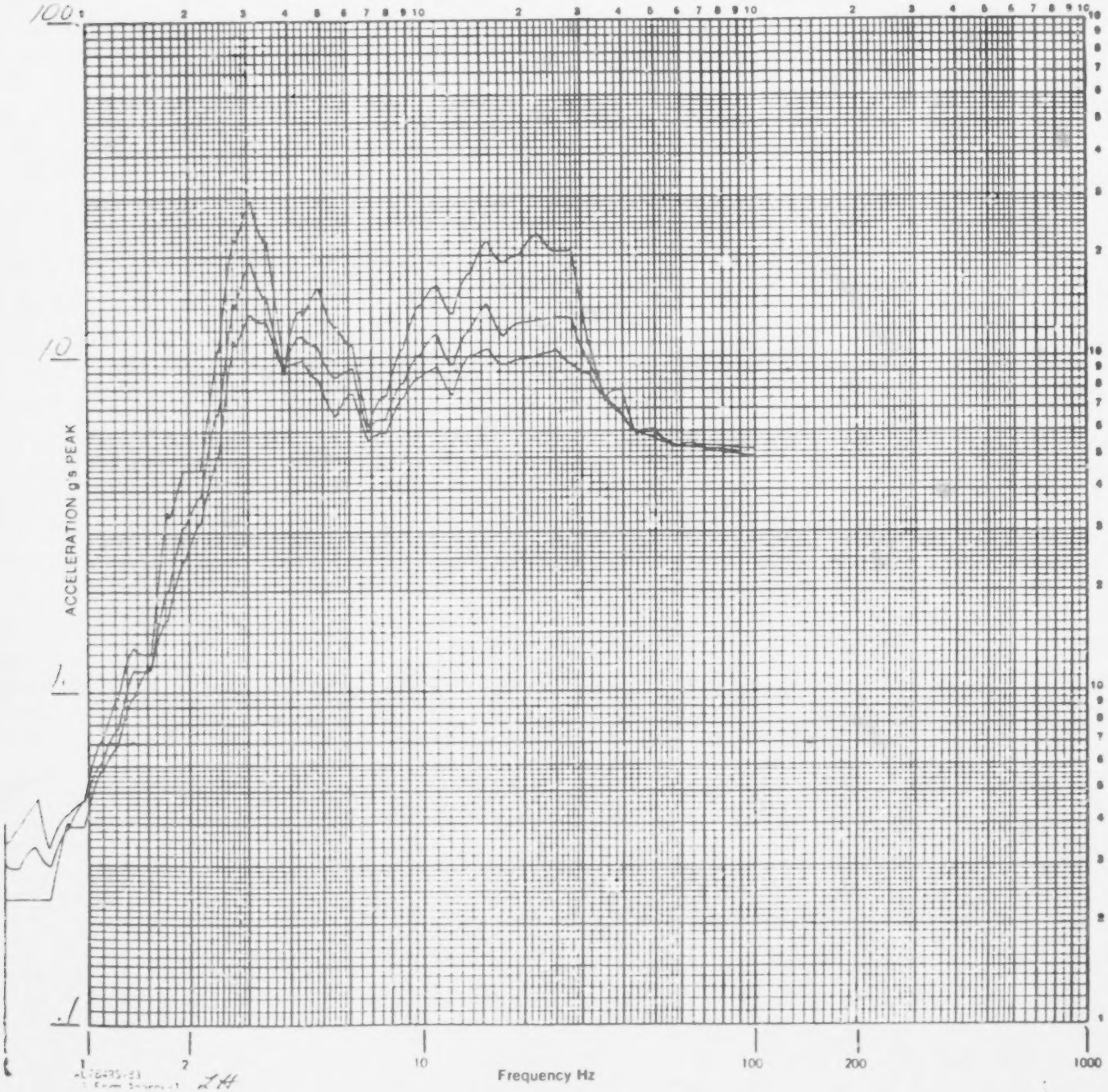
Accel. No. 8 Axis X Control ( ) Response ( ) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 4, 3 % Run No. 46

Operato GEEREMAN Engineer

5th Level 30 Hz

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 12-5-85

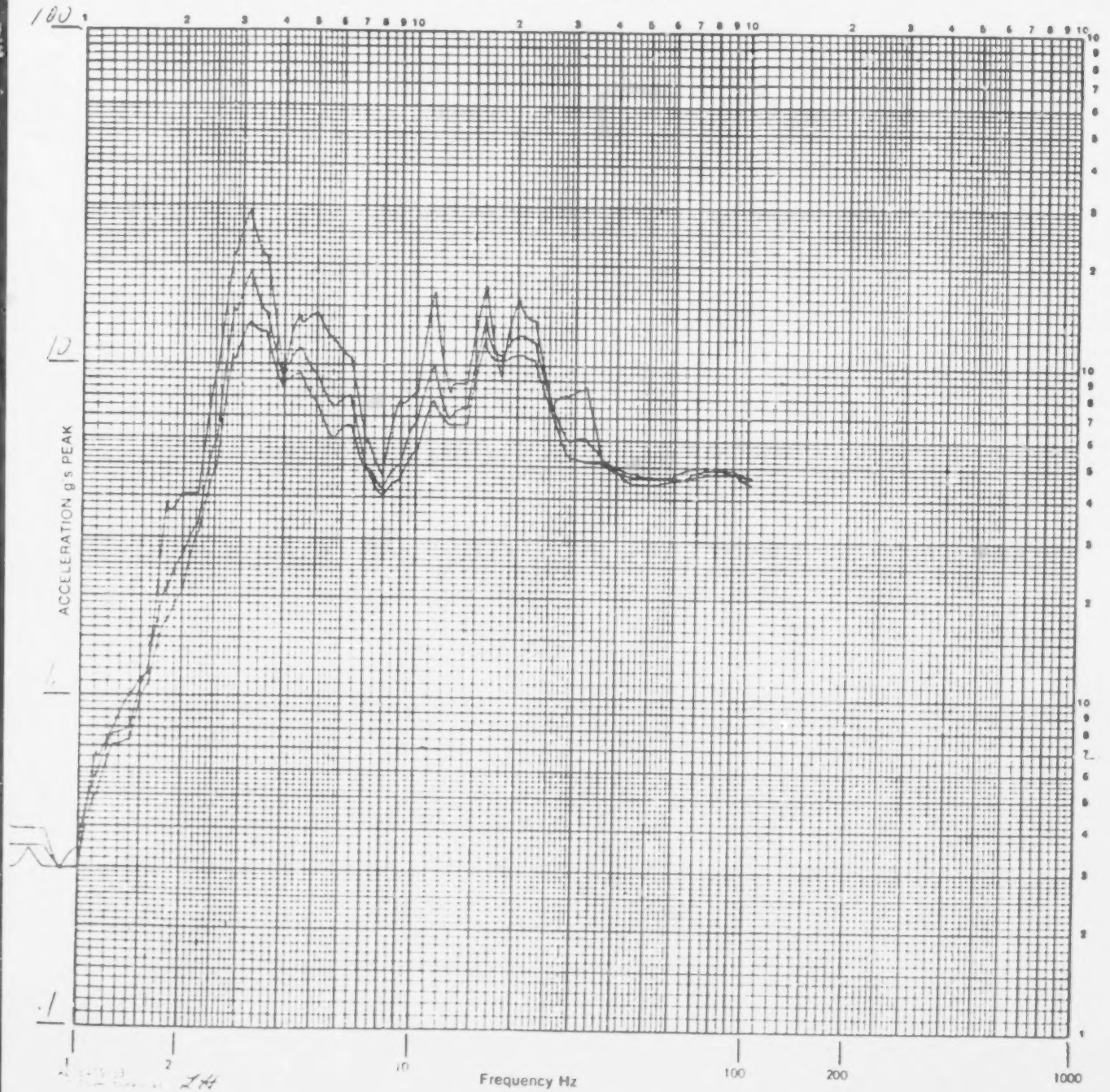
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 9 Axis Y Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 46

Operator GREIERMAN Engineer [signature] 5th LEVEL 30 Hz

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 12-5-85

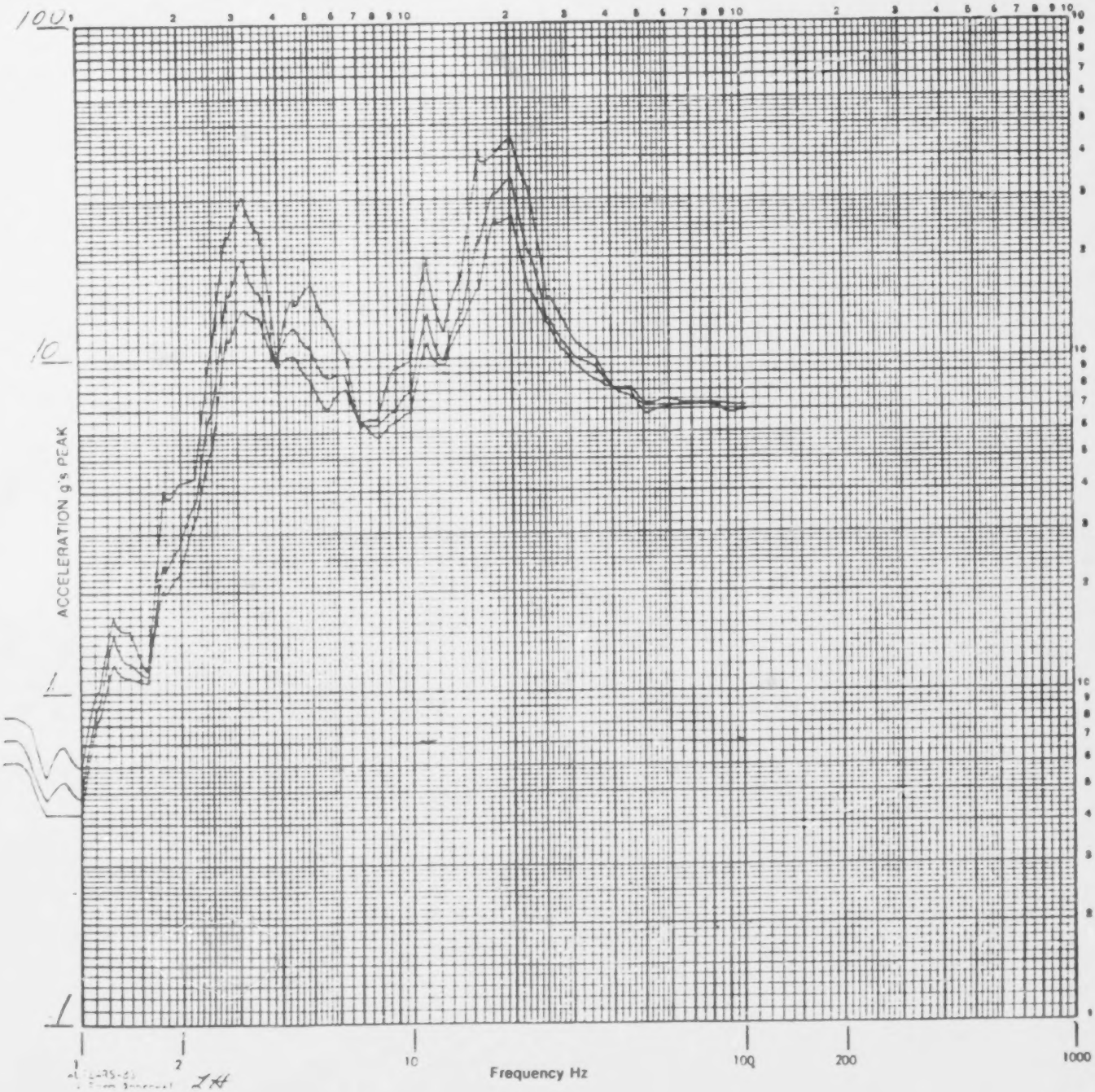
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 10 Axis Y Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 46

Operator GREIERMAN Engineer [signature] 5th LEVEL 30 HZ

RESPONSE SPECTRUM



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CUSTOMER L-L.N.L. Job No. 26447 Date 12-5-85

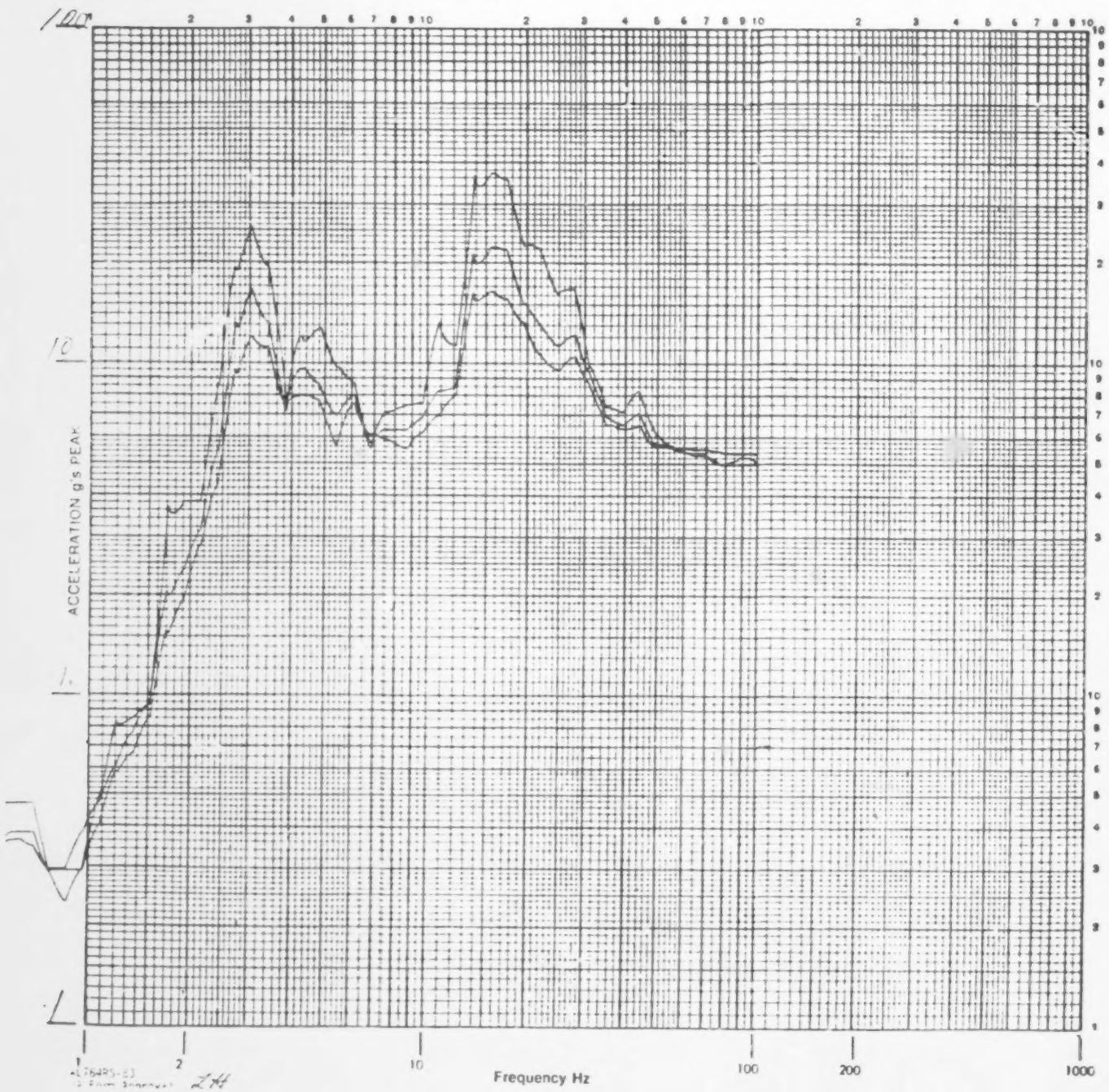
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 11 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 46

Operator GREENMAN Engineer [signature] 5th LEVEL 30 HZ

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 12-5-85

Specimen MOTOR CONTROL UNIT Axis of Test X-Y

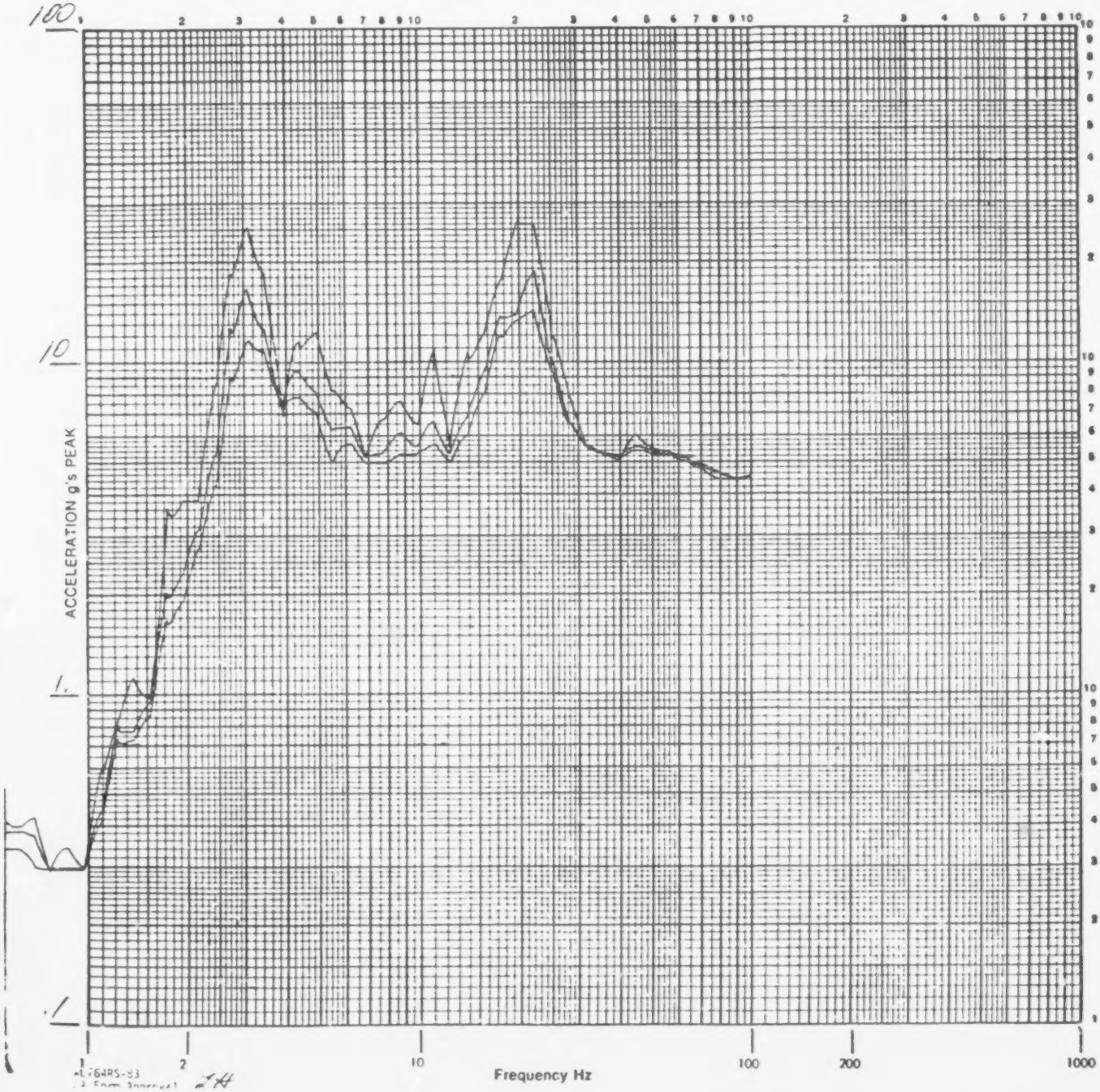
Accel. No. 13 Axis Y Control ( ) Response (4 OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 46

Operato GREENMAN Engineer

5TH LEVEL 30 HZ

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 12-5-85

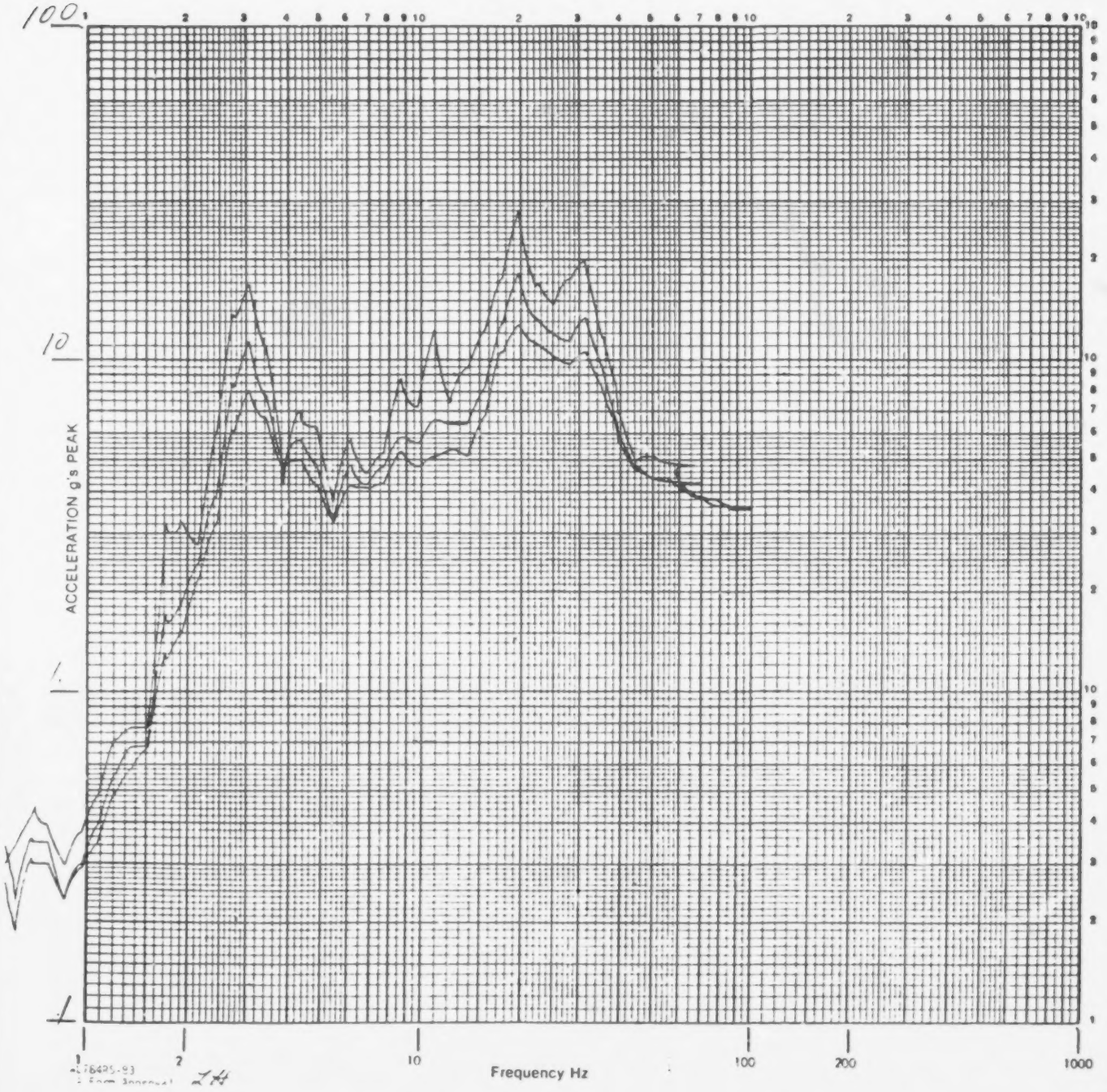
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 14 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 46

Operator GEETERMAN Engineer [signature] 5th LEVEL 30 HZ

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 12-5-85

Specimen MOTOR CONTROL UNIT Axis of Test X-Y

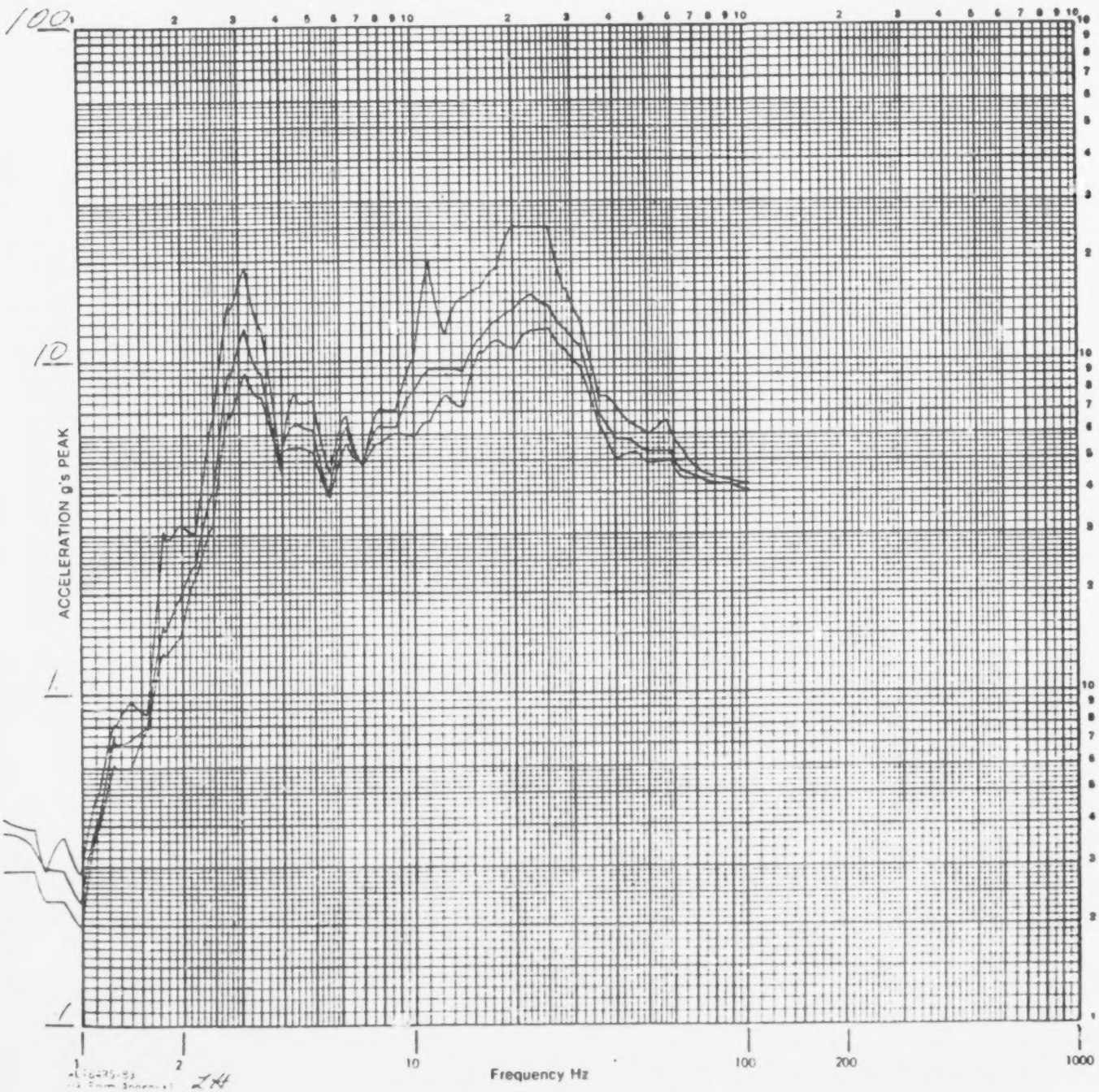
Accel. No. 15 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 46

Operato GREENMAN Engineer [signature]

5B Level 30 Hz

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 12-5-85

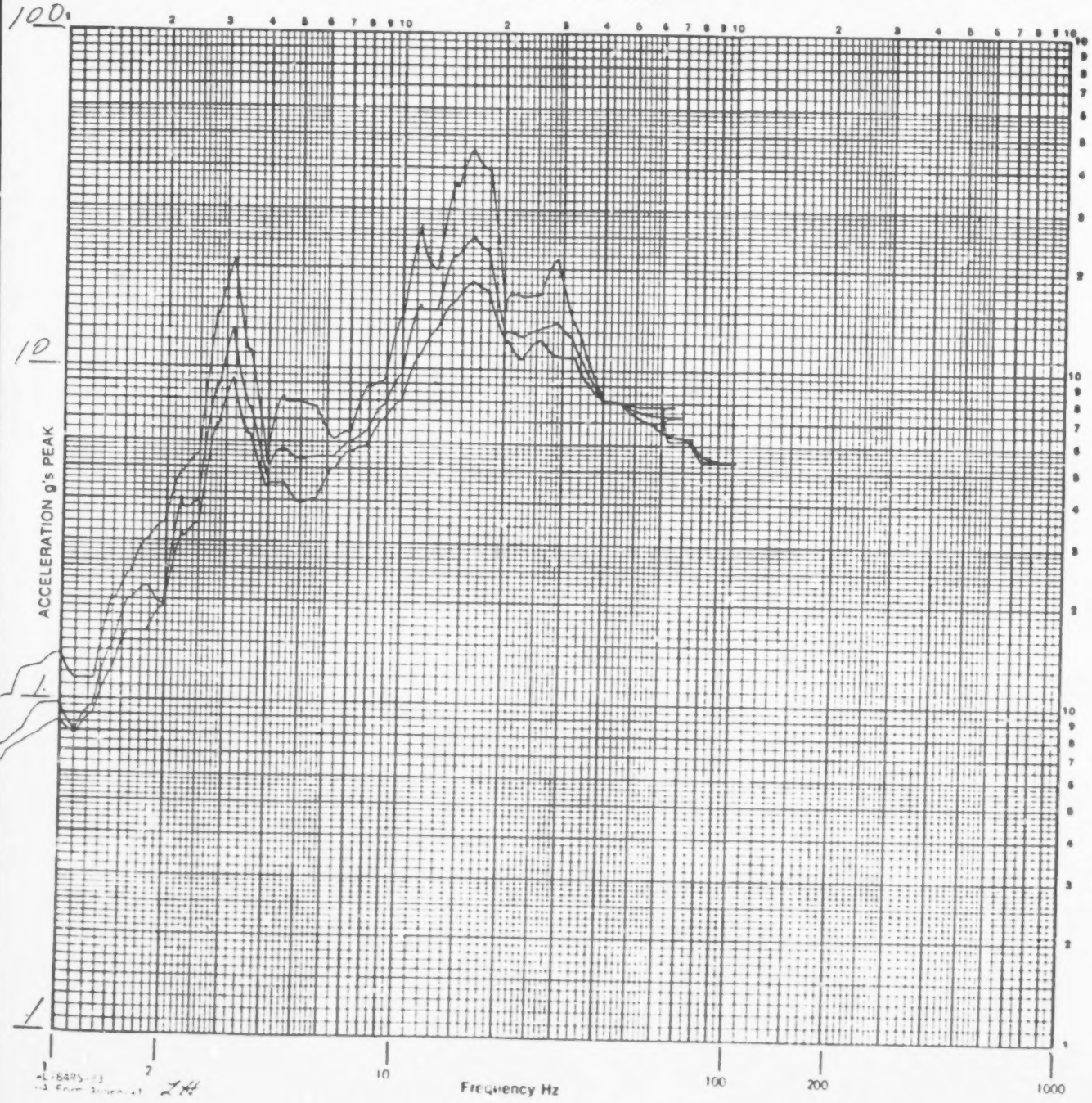
Specimen MOTOR C TROL UNIT Axis of Test X-Y

Accel. No. 16 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 46

Operator GREIERMAN Engineer [illegible] 5B LEVEL 30 Hz

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 12-5-85

Specimen MOTOR CONTROL UNIT Axis of Test X-Y

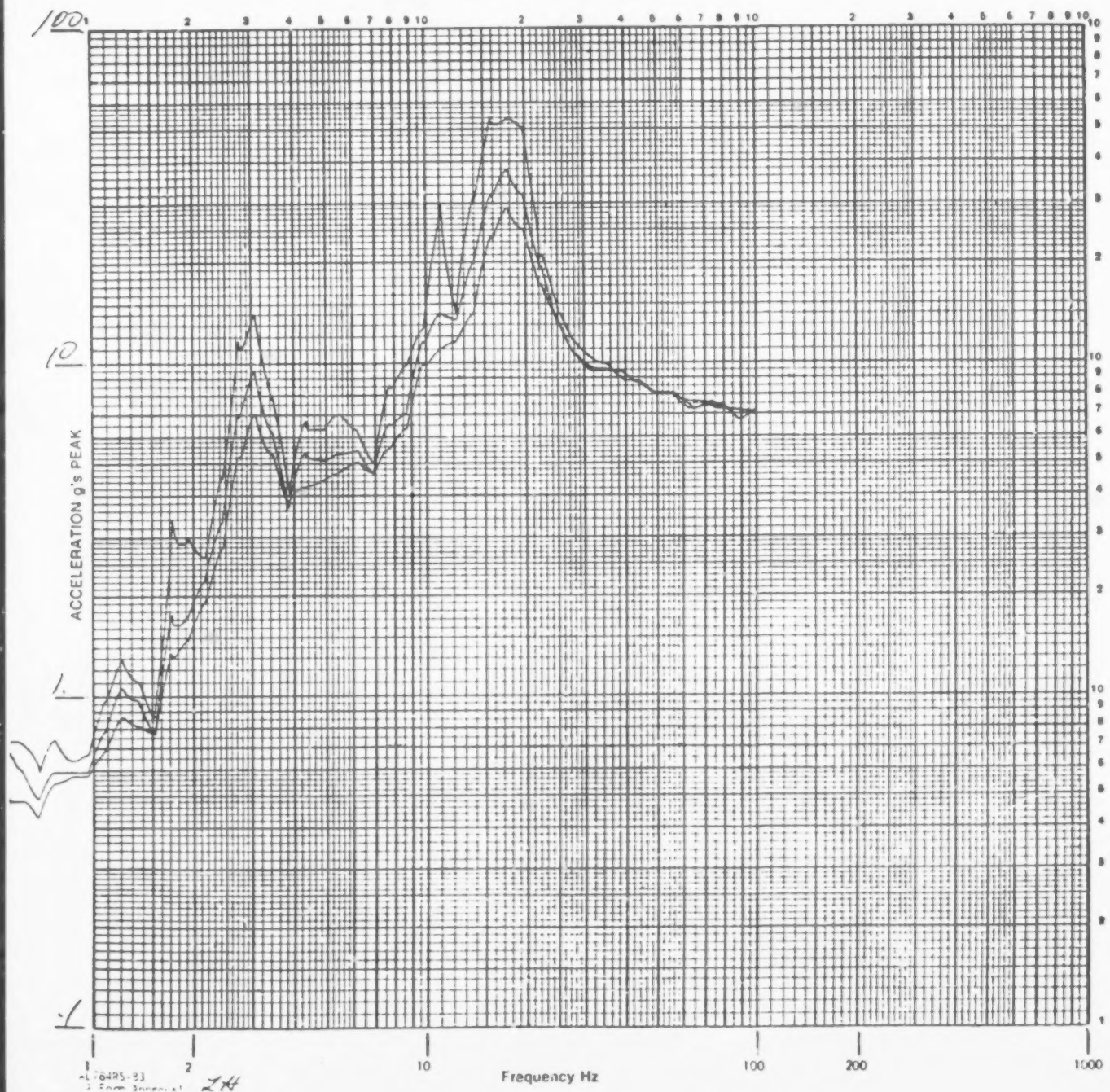
Accel. No. 17 Axis X Control ( ) Response ( ) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5,4,3 % Run No. 46

Operator GREIERMAN Engineer

5B LEVEL 30 HZ

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 12-5-85

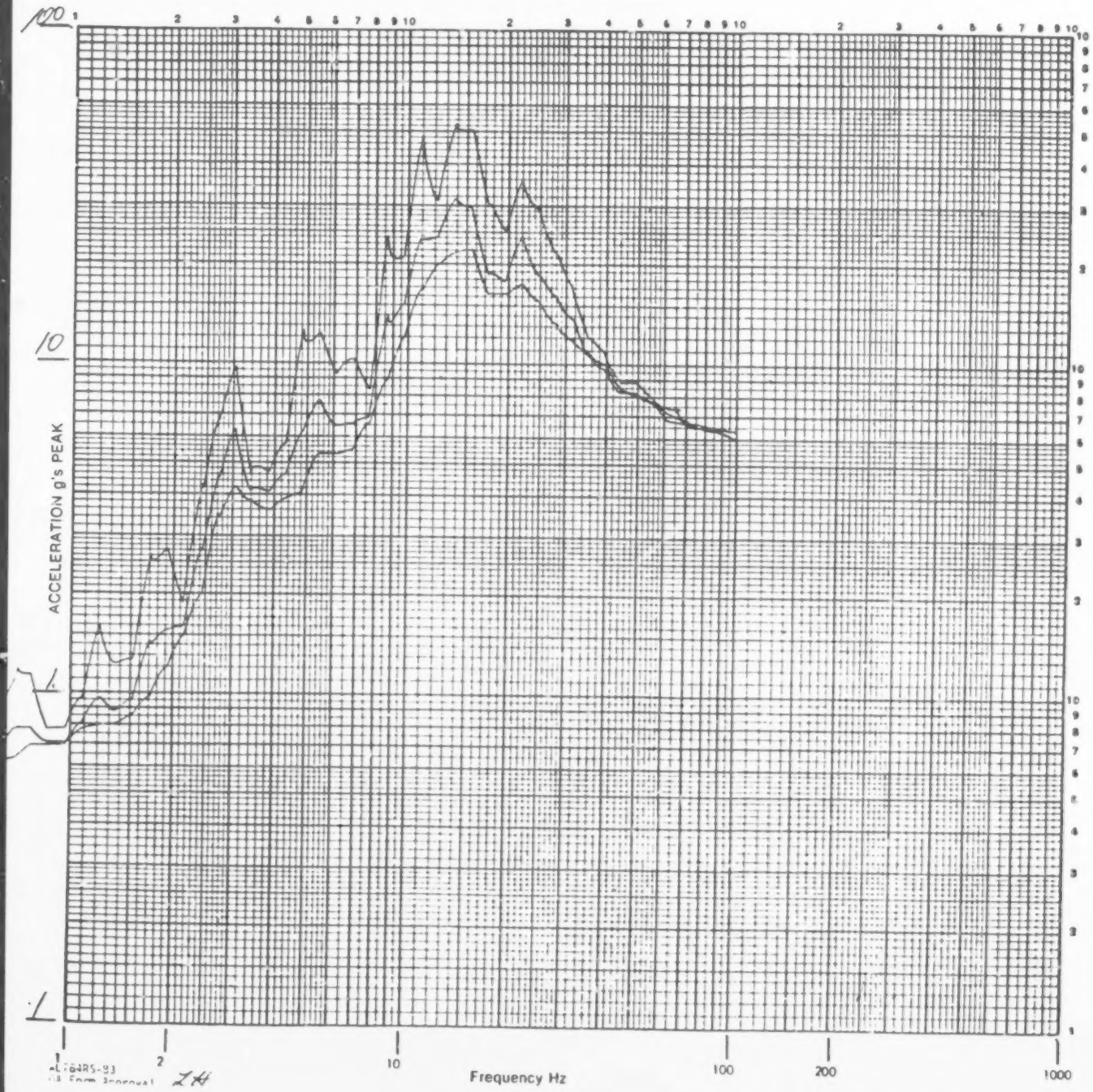
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 18 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 46

Operator GREIERMAN Engineer [signature] 5th LEVEL 30 Hz

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 12-5-85

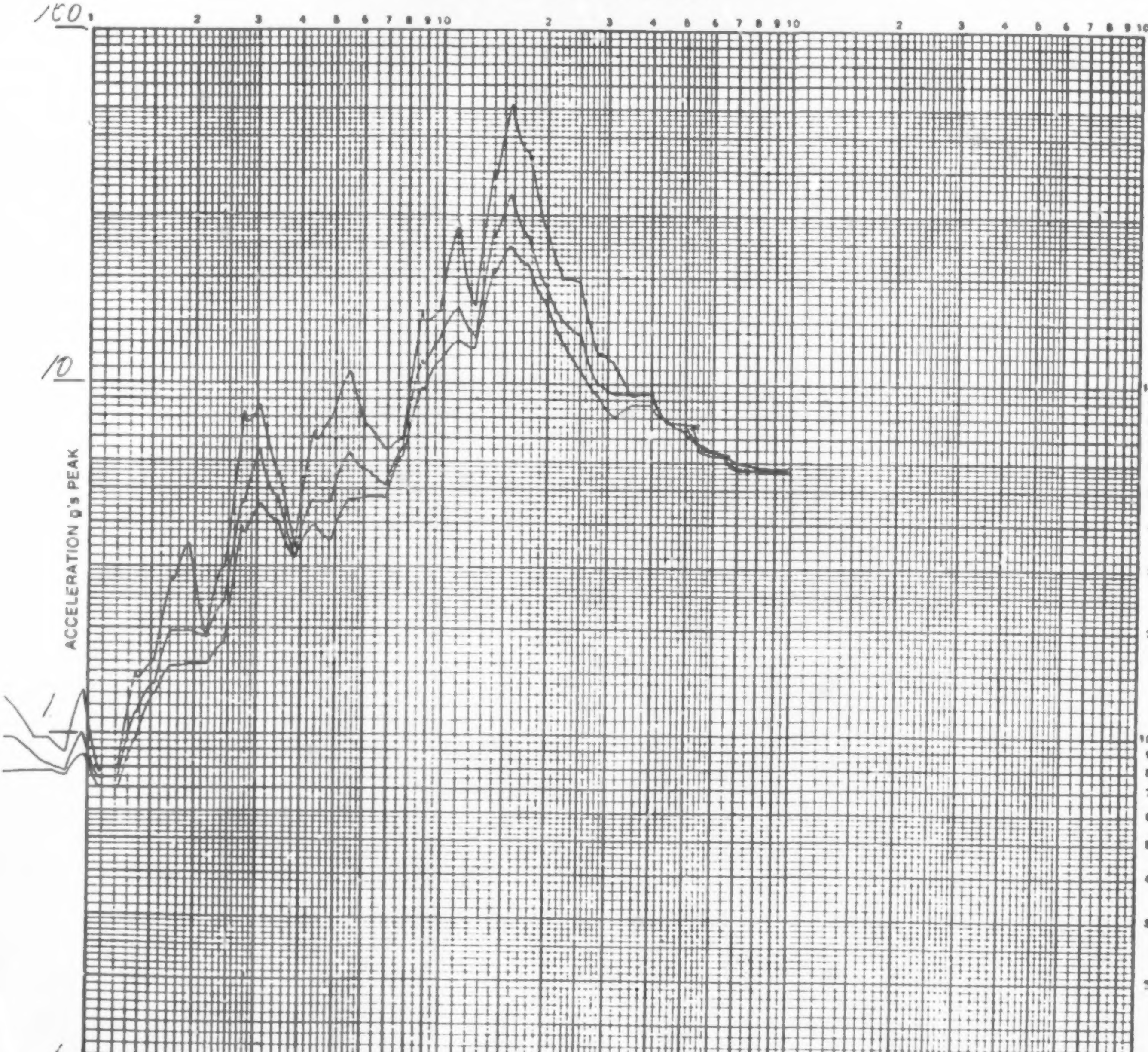
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel. No. 19 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 %   Run No. 46

Operator BREIERMAN Engineer [signature]   5B LEVEL 30 HZ

RESPONSE SPECTRUM



WL784RS-33
2H

RUN 56

Four bolts per column with internal bracing, 2.2g table ZPA

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CUSTOMER L. L. N. L. Job No. 26447 Date 12-11-85

Specimen MOTOR CONTROL CENTER Axis of Test X-Y

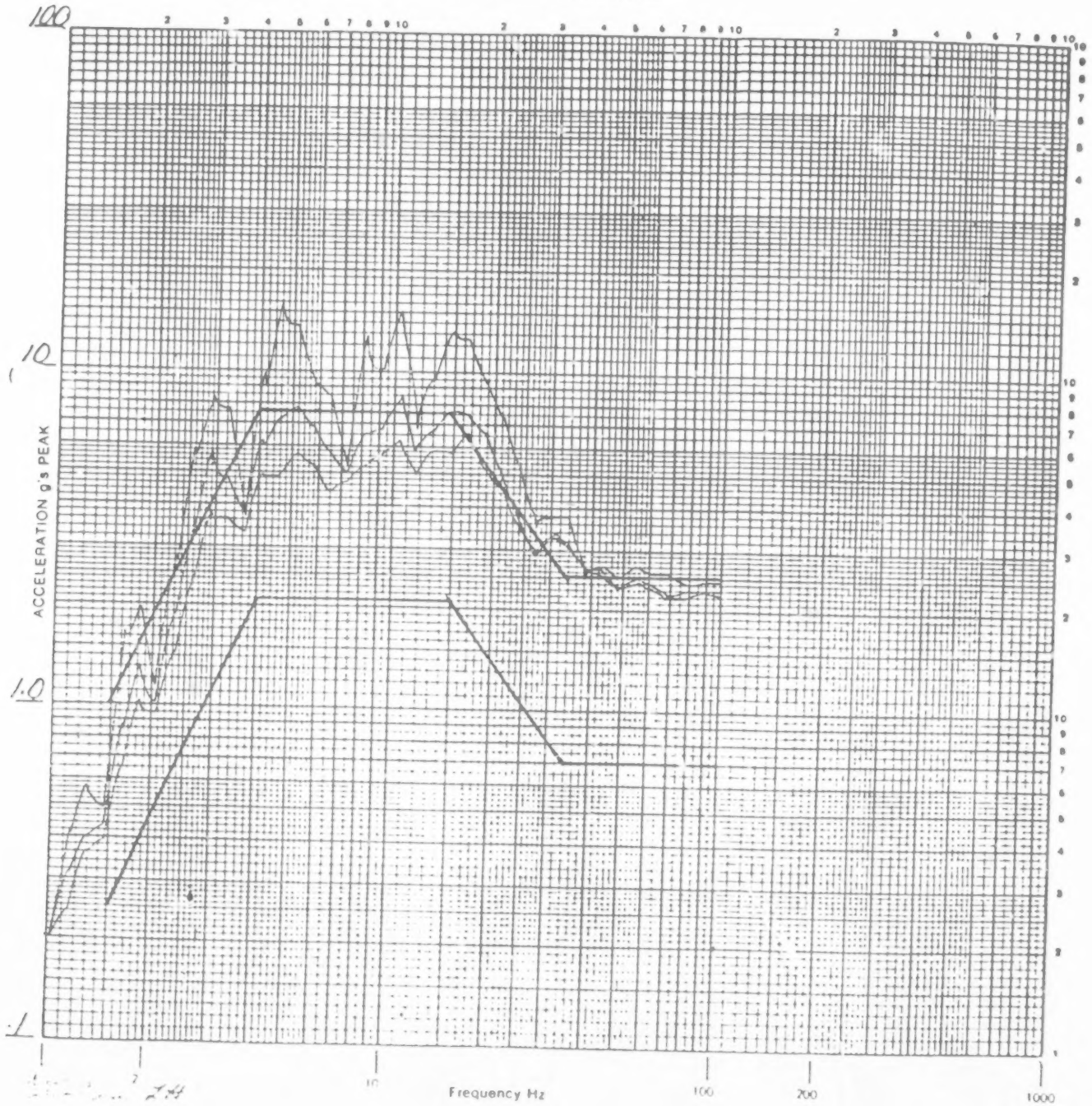
Accel. No. 1 Axis HORIZ Control (✓) Response ( ) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 56

Operator GREFERMAN Engineer

5TH LEVEL

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 12-11-85

Specimen MOTOR CONTROL CENTER Axis of Test X-Y

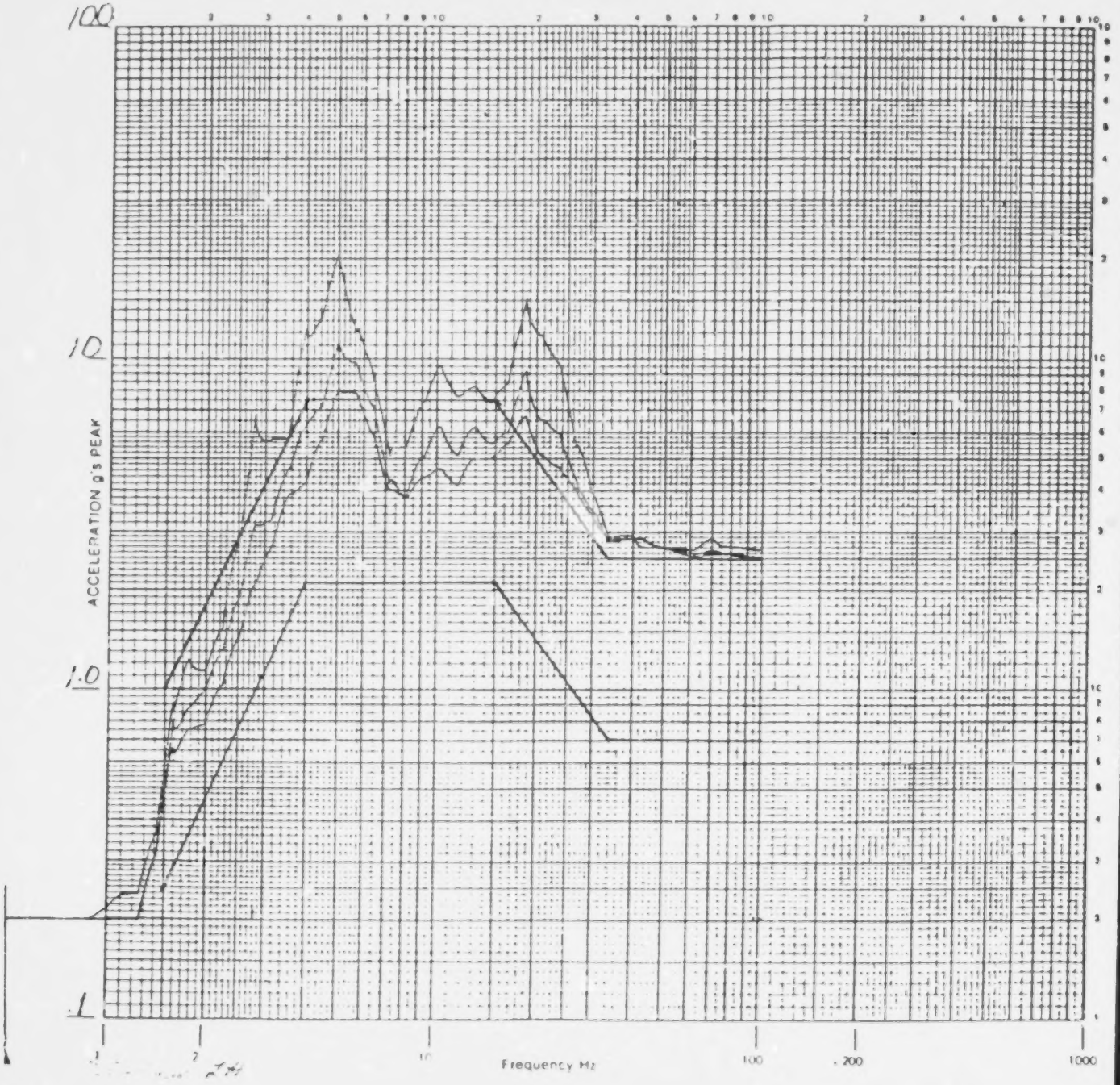
Accel. No 2 Axis VERT Control ( ) Response ( ) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 3 % Run No 36

Operator GREIERMAN Engineer

5% LEVEL 30HZ

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No 26447 Date 12-11-95

Specimen MOTOR CONTROL UNIT Axis of Test X-Y

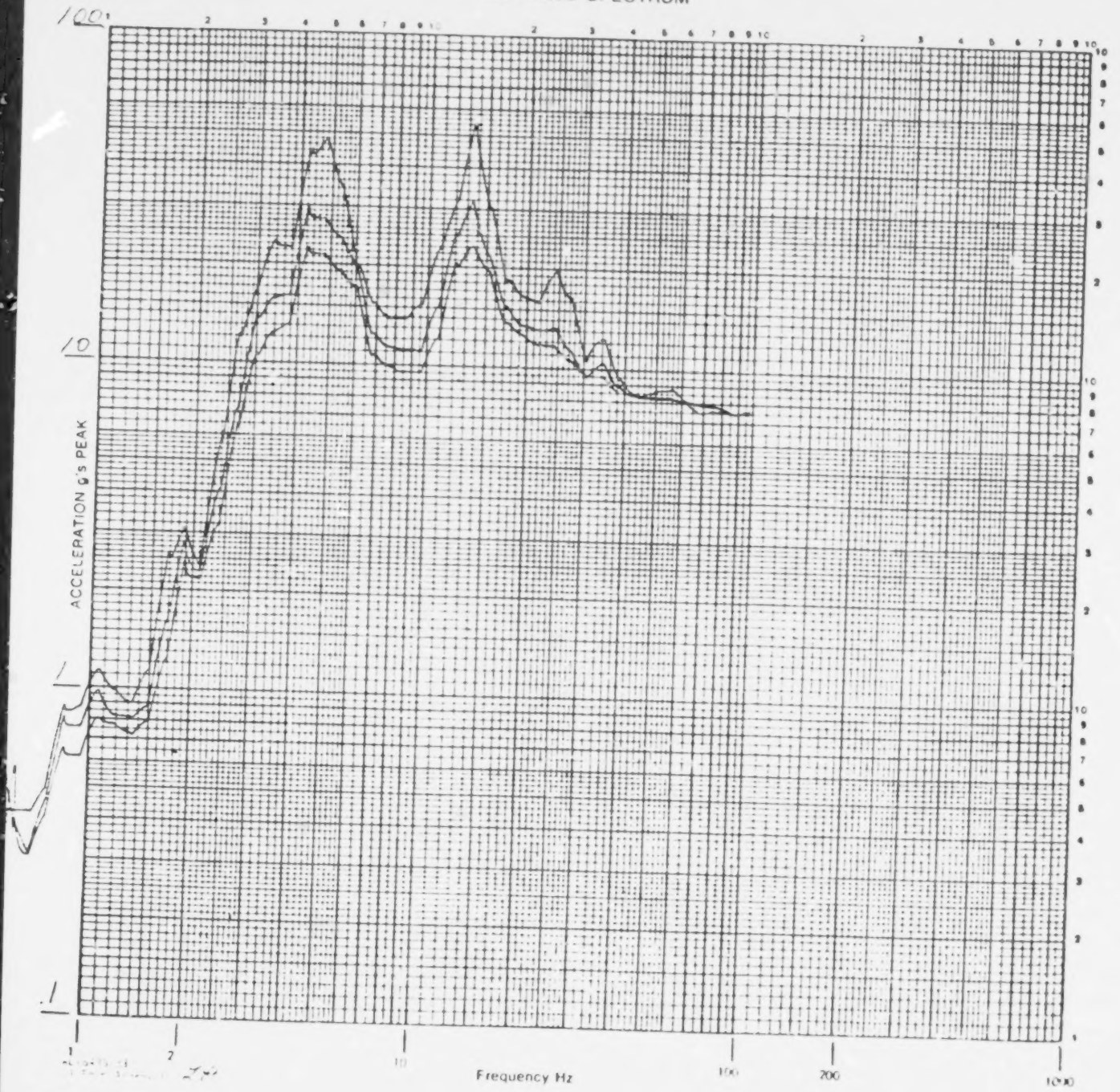
Accel No 8 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No 56

Operator [illegible] Engineer [illegible]

5TH LEVEL 30HZ LO-PASS

RESPONSE SPECTRUM



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CUSTOMER L. L. N. L. Job No 26447 Date 12-11-85

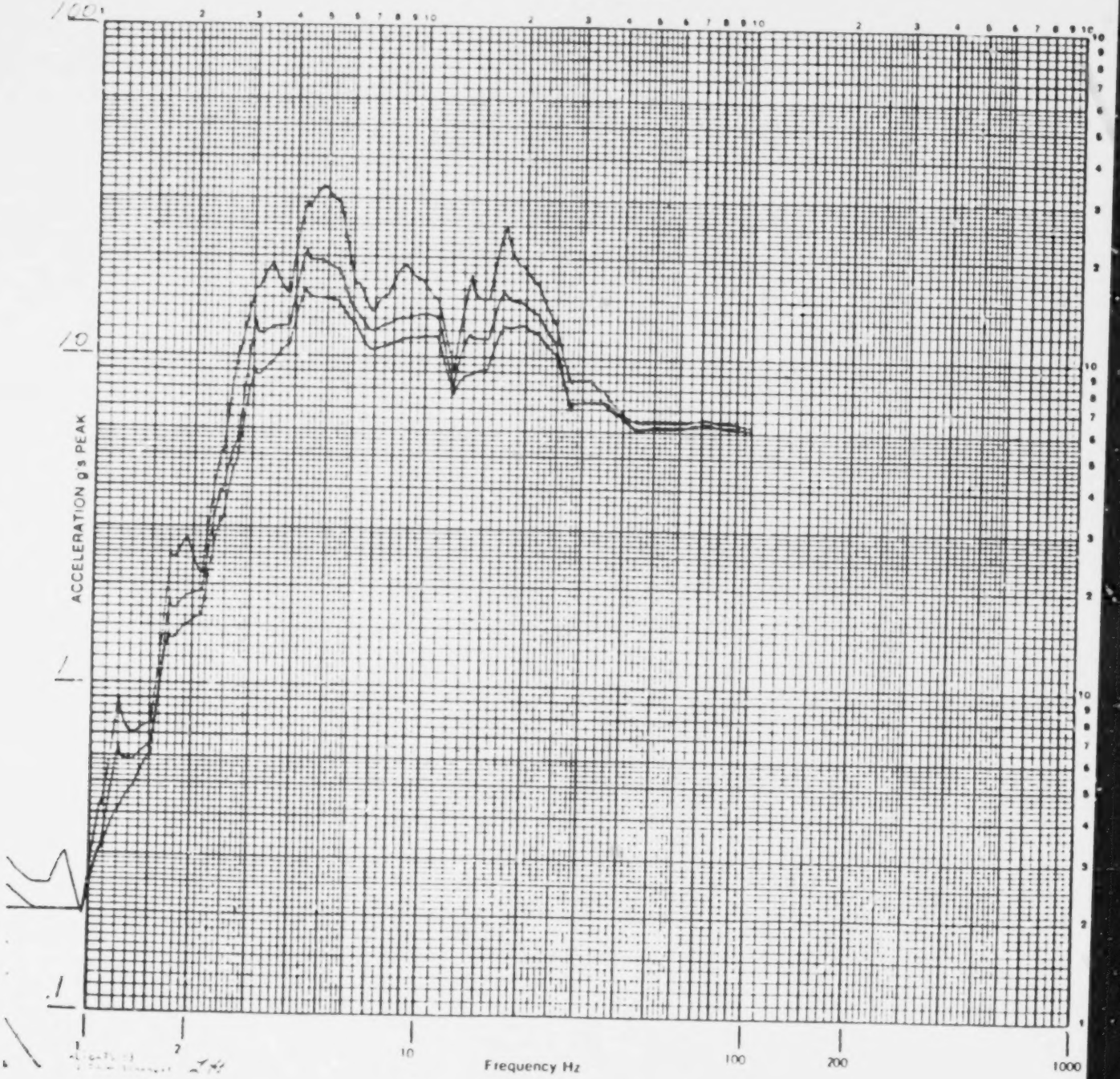
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel No 9 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No 56

Operator [illegible] Engineer [illegible] 5th LEVEL 30Hz Lo-Pass

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Axis of Test X-Y

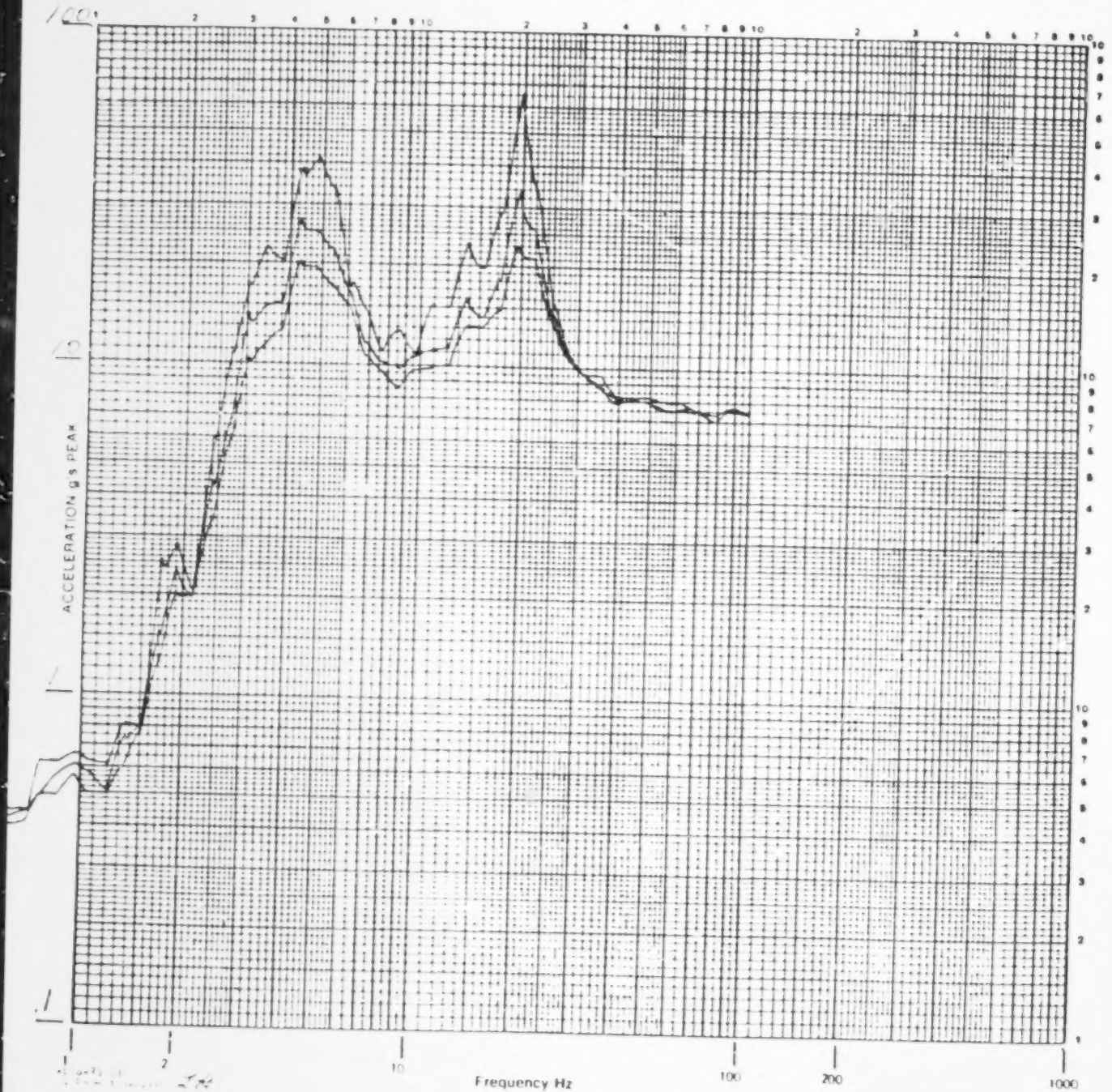
Accel No 10 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No 56

Operator [illegible] Engineer [illegible]

5% LEVEL 30HZ LO-PASS

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No 26447 Date 12-11-85

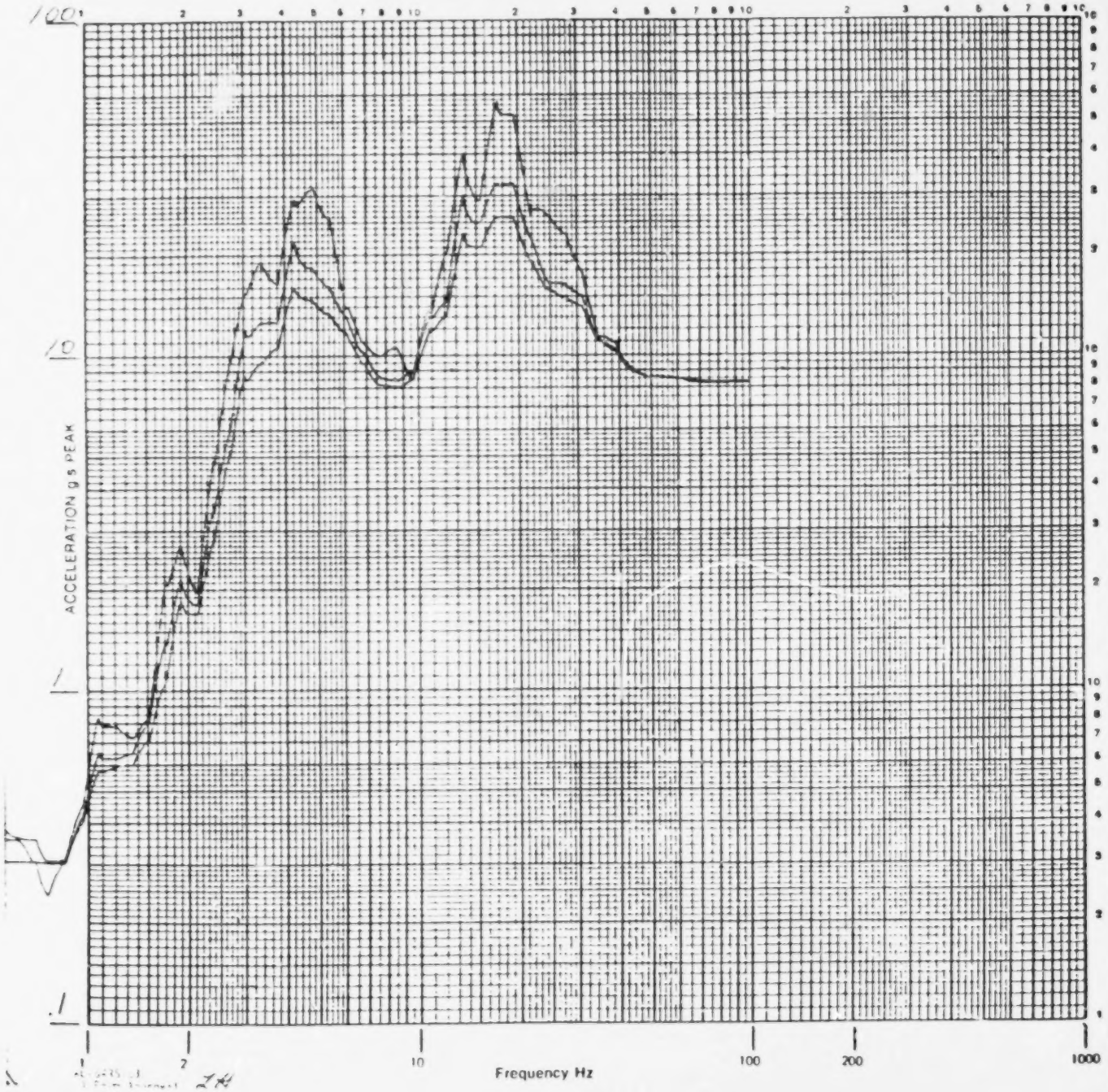
Specimen MOTOR CONTROL UNIT Axis of Test X-Y

Accel No 11 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 5, 6

Operator [illegible] Engineer [illegible] 5th LEVEL 30HZ LO-PASS

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Axis of Test X-Y

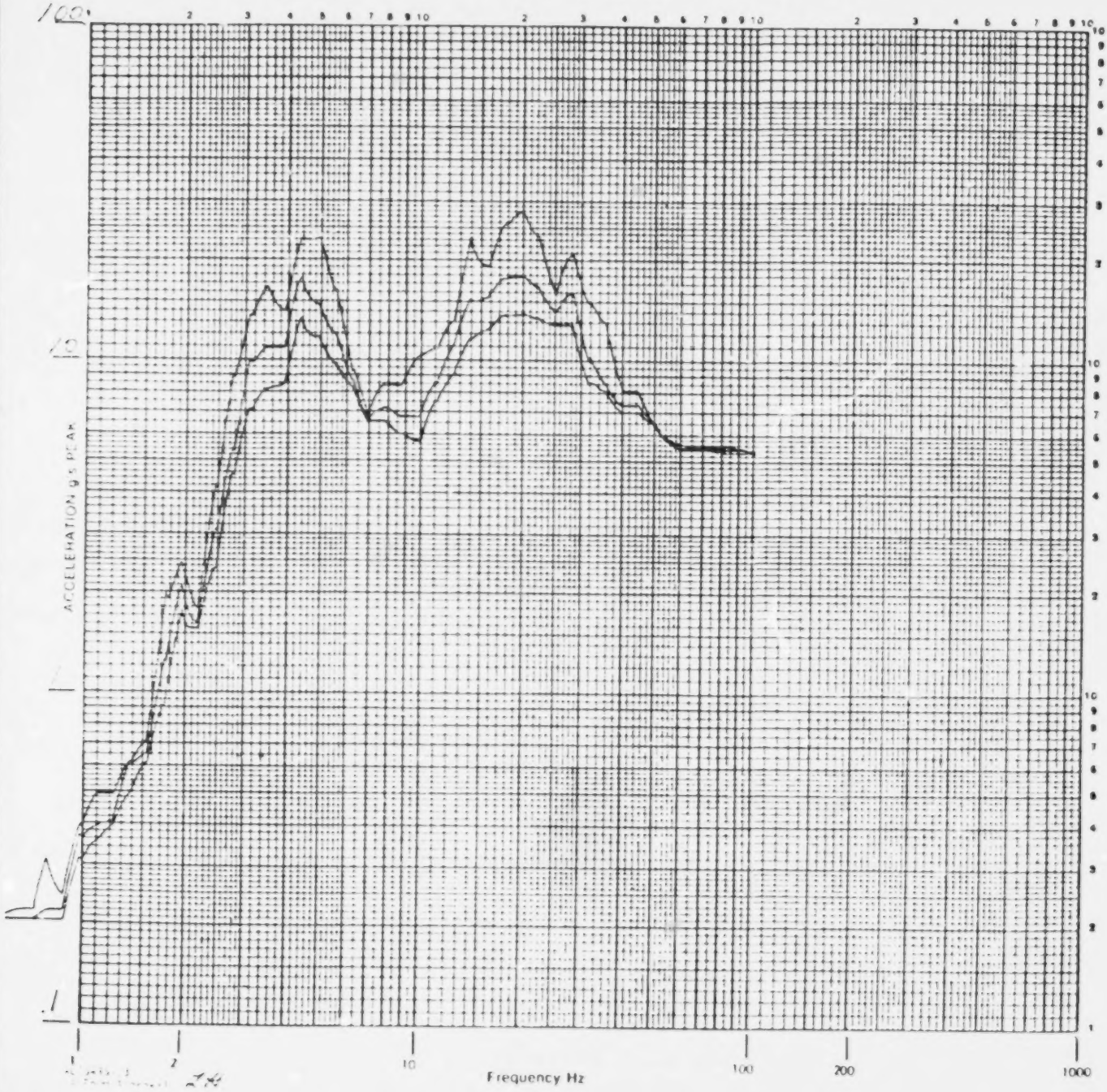
Accel No. 14 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 56

Operator [signature] Engineer [signature]

5TH LEVEL 30HZ LO-PASS

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No. 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Axis of Test X-Y

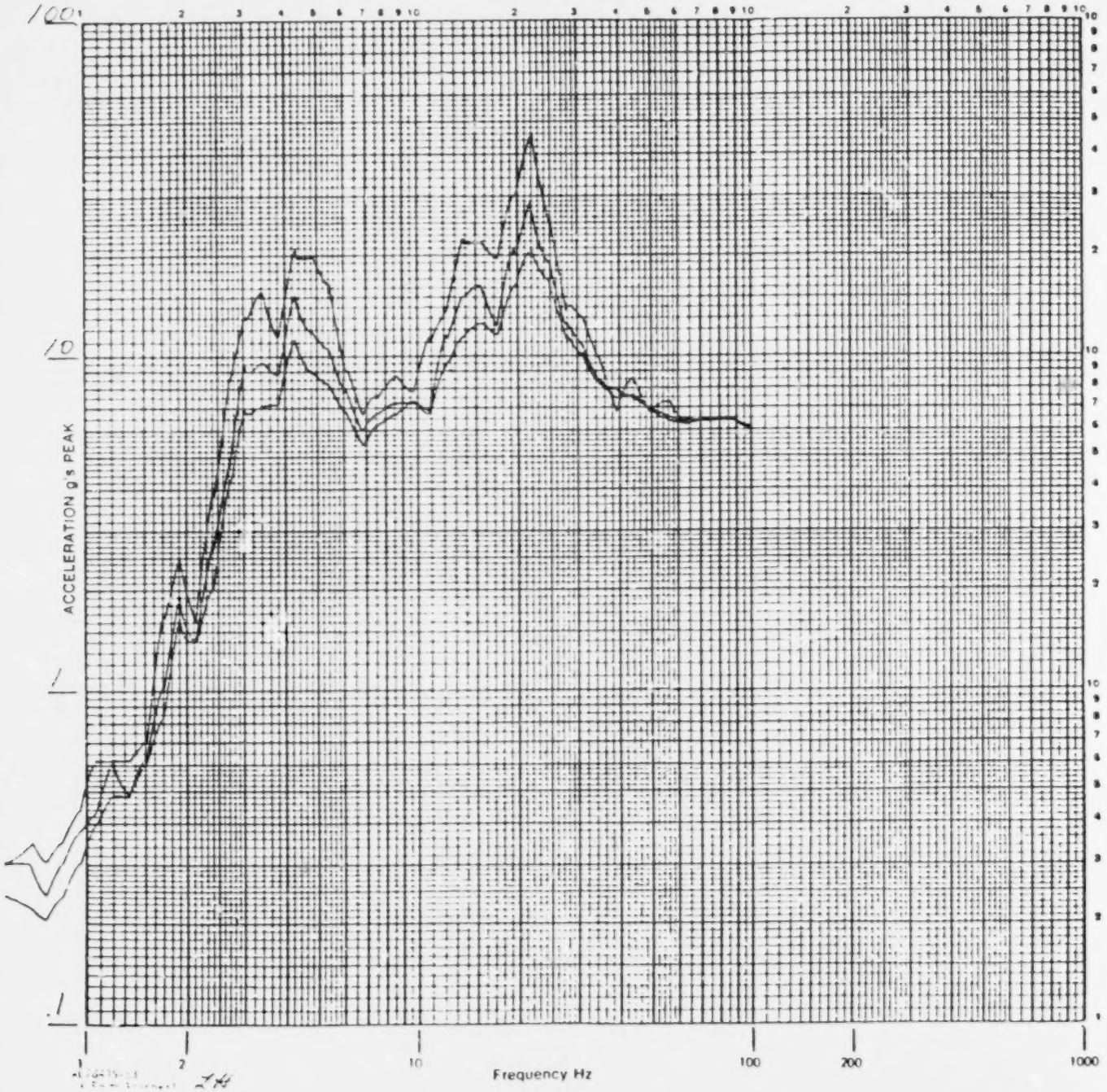
Accel. No 15 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 56

Operator [illegible] Engineer [illegible]

5TH LEVEL 30HZ LO-PASS

RESPONSE SPECTRUM



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CUSTOMER L. L. N. L. Job No. 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Axis of Test X-Y

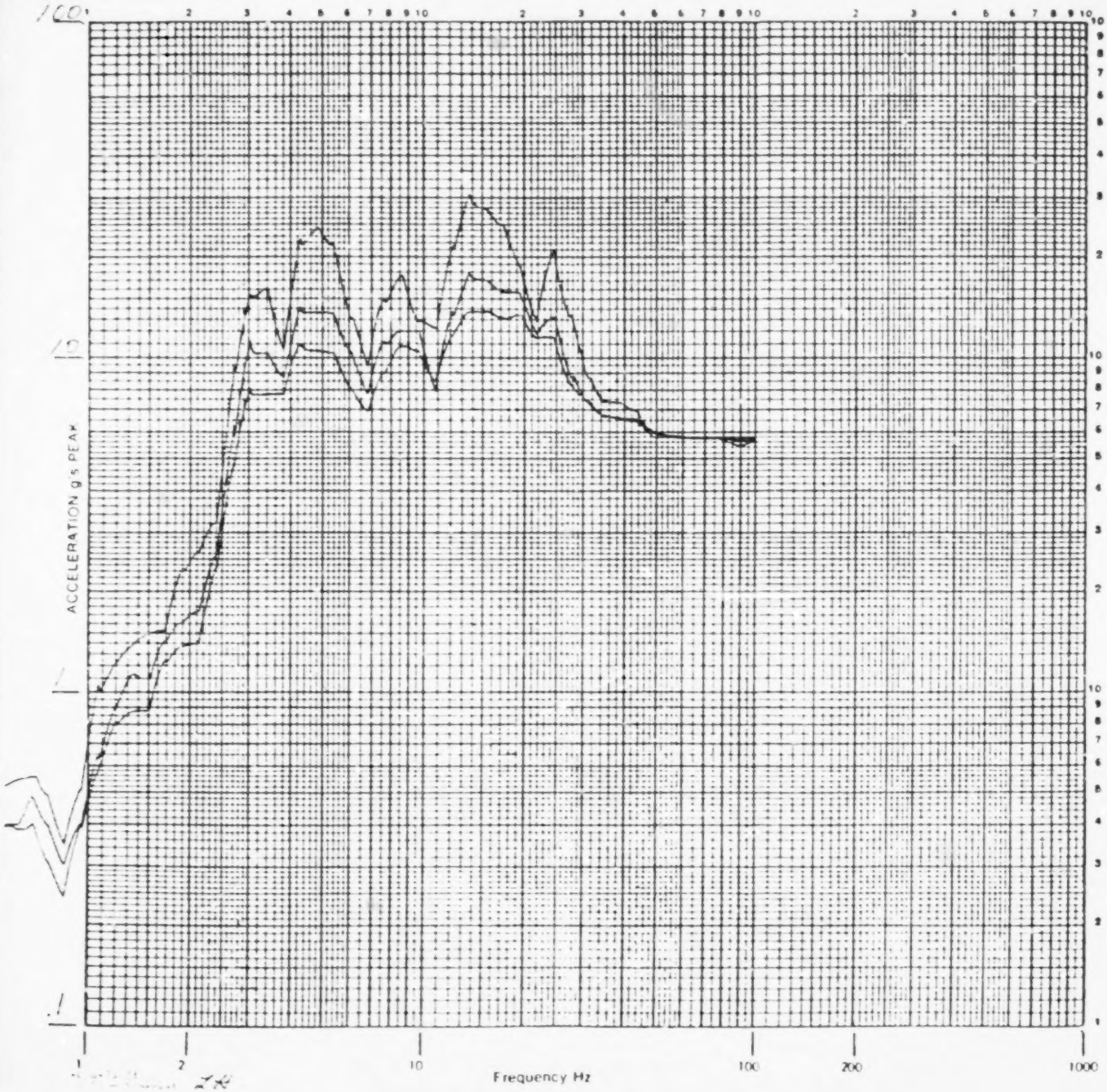
Accel. No. 16 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 56

Operator [illegible] Engineer [illegible]

5TH LEVEL 30HZ LO-PASS

RESPONSE SPECTRUM



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CUSTOMER L. L. N. L. Job No. 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Axis of Test X-Y

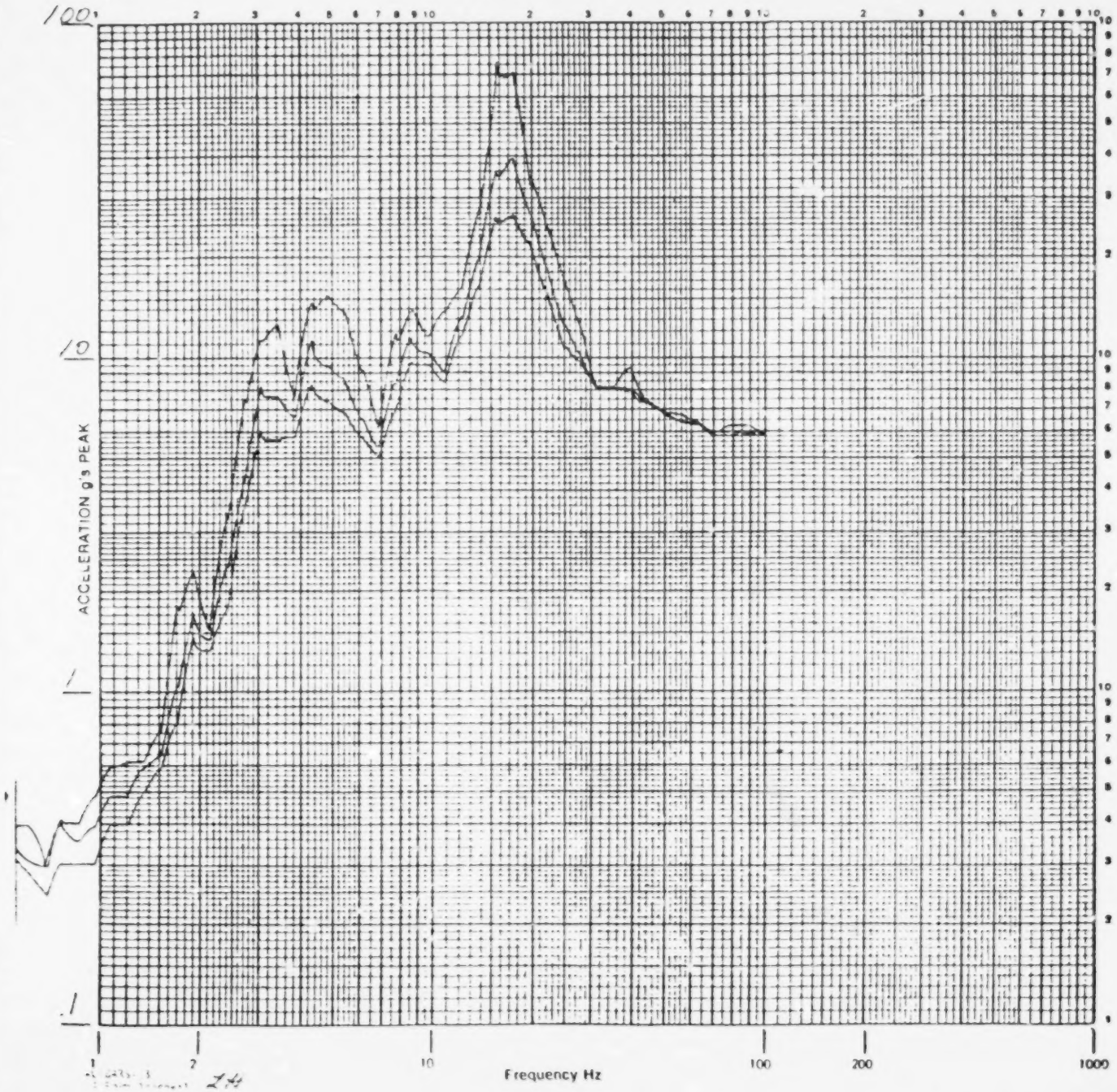
Accel. No. 17 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 56

Operator [illegible] Engineer [illegible]

5TH LEVEL 30HZ LO-PASS

RESPONSE SPECTRUM



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CUSTOMER L.L.N.L. Job No 26447 Date 12-11-85

Specimen MOTOR CONTROL UNIT Axis of Test X-Y

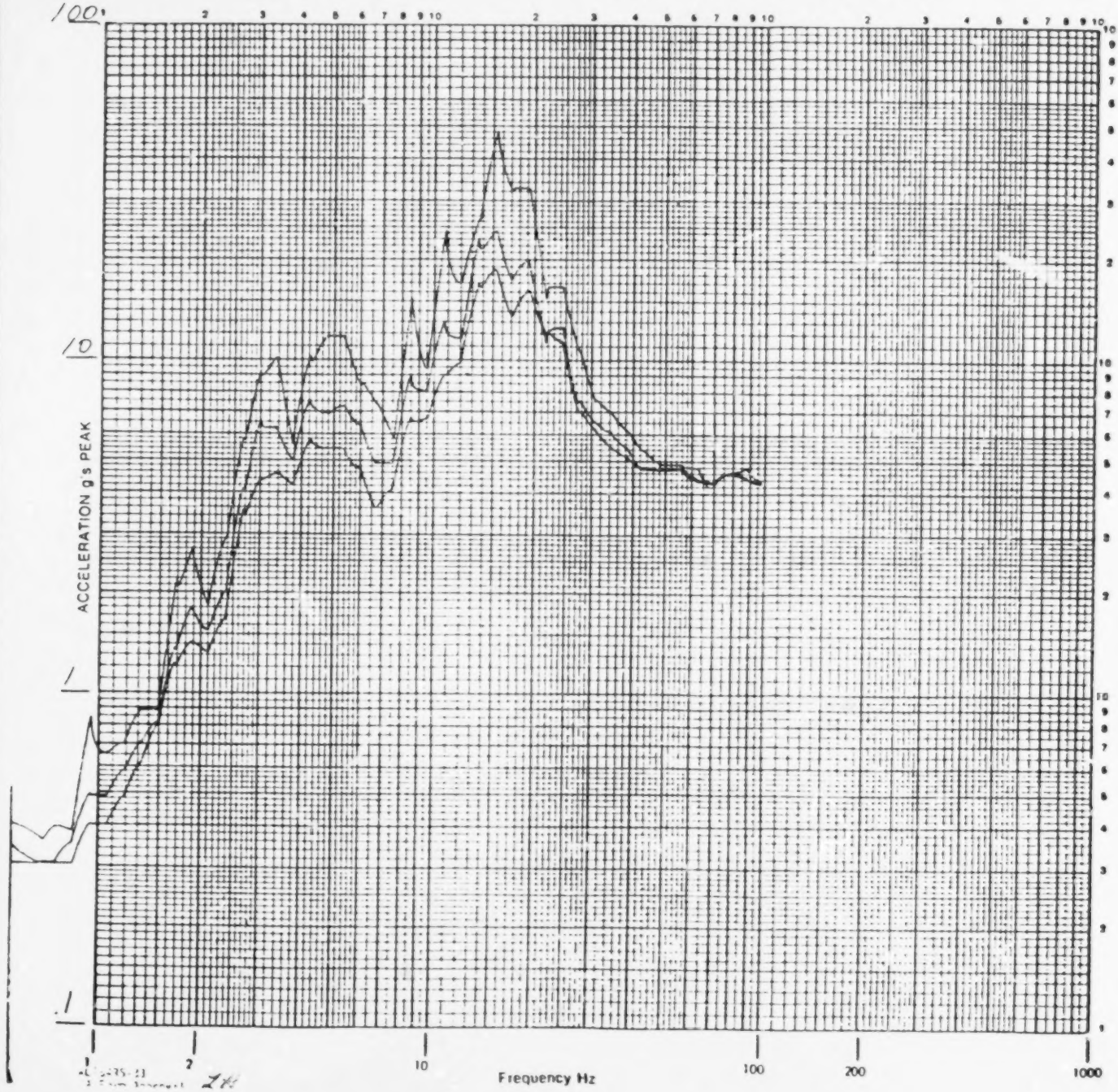
Accel. No. 19 Axis X Control ( ) Response (✓) OBE ( ) SSE ( ) DBE ( )

Full Scale 100 g Damping 5, 1, 3 % Run No. 56

Operator [illegible] Engineer [illegible]

5TH LEVEL 30HZ LO-PASS

RESPONSE SPECTRUM



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SEE INSTRUCTIONS ON THE REVERSE

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NUREG/CR-4900
UCID-21002
Vol. 2

2. TITLE AND SUBTITLE
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Phase I Demonstration Tests

Appendices

3 LEAVE BLANK

4 DATE REPORT COMPLETED
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YEAR: 1986

5. AUTHOR(S)
G.S. Holman, C.K. Chou, G.D. Shipway*, V. Glozman*
*Wyle Laboratories

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b PERIOD COVERED (Inclusive dates)

12 SUPPLEMENTARY NOTES

13 ABSTRACT (200 words or less)

This report describes tests performed in Phase I of the NRC Component Fragility Research Program. The purpose of these tests was to demonstrate procedures for characterizing the seismic fragility of a selected component, investigating how various parameters affect fragility, and finally using test data to develop practical fragility descriptions suitable for application in probabilistic risk assessments. A three-column motor control center housing motor controllers of various types and sizes as well as relays of different types and manufacturers was subjected to seismic input motions up to 2.5g zero period acceleration. To investigate the effect of base flexibility on the structural behavior of the MCC and on the functional behavior of the electrical devices, multiple tests were performed on each of four mounting configurations: four bolts per column with top bracing four bolts per column with no top brace, four bolts per column with internal diagonal bracing, and two bolts per column with no top or internal bracing. Device fragility was characterized by contact chatter correlated to local in-cabinet response at the device location. Seismic capacities were developed for each device on the basis of local input motion required to cause chatter; these results were then applied to develop probabilistic fragility curves for each type of device, including estimates of the "high-confidence" low probability of failure" capacity of each.

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